BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.

Director of Public Gardens and Plantations.

Vol. II.

HOPE GARDENS, JAMAICA:

1904.

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NOTES ON NITRIFICATION.

By H. H. Cousins, M.A. (Oxon), F.C.S.

The last legacy of Death is the first food of Life.

This axiom of Nature, when referred to the nitrogen contained in living things, finds its justification and realisation in fact by the relationship of nitrates to the decay and the re-creation of the materials of which all forms of life are composed. The last stage in the decay of nitrogenous matter from plants and animals is that of the nitrates formed in the soil, and this again is the first stage in which the dead matter is taken up afresh by the growing plant and re-created into the substance of living matter.

In the tropics this cycle is appreciably accelerated by conditions favourably adapted towards swiftness of decay and a regeneration frequently miraculous in the speed of its attainment.

A knowledge of the process of nitrification underlies an intelligent comprehension of the principles of soil management, of cultivation and manuring.

Since the hurricane, the favourable conditions for the progress of nitrification have painted the entire vegetation of Jamaica a darker and fuller green from the free supply of nitrates which our plants and trees have recently obtained

The most valuable commercial form of nitrogenous fertilizers for use in a tropical country of free rainfall, as in the cultivated areas of Jamaica, is Sulphate of Ammonia.

An attempt will be made to give an account of the process whereby ammonia derived from organic decay or the commercial fertilizer is converted into nitrate for the direct nutrition of a crop.

Nitrification.

Although plants are able to feed upon ammonia dissolved in the soil water, they rarely do so under normal conditions. It has been found that during the growing season of the year, i.e. continuously in

the tropics, ammonia is being steadily converted into *nitrates* in the soil, and that plants avail themselves of these soluble salts for their supply of nitrogenous nourishment It is therefore necessary in considering the manurial effect of sulphate of ammonia to go beyond the stage of its absorption by the soil and to study the conditions under which the nitrogen of the ammonia is converted into nitrate. This latter process is known as *nitrification*, and although its practical working has been recognised for centuries in the manufacture of nitre, it was only by the assistance of modern bacteriology that the exact cause and mechanism of the process have become clear and intelligible

The change of ammonia into nitrates in the soil early attracted the attention of chemists. *Boussingault* studied this change as occurring in cultivated soil, and found the amount of nitrate present at any one time to be dependent on the rainfall. After heavy rains the nitrates were washed out, while during dry weather an accumulation again took place. In 1846 *Dumas* concluded from his experiments that nitrification was a purely chemical process of oxidation, and regarded nitrate as the direct outcome of the combined action of chalk, oxygen and ammonia. Other chemists ascribed the action to the porous organic matter in the soil which was supposed to have the same powers of oxidation as that possessed by the aërated pores of charcoal.

In 1862 *Pasteur* suggested that this change was analagous to that of the souring of beer or the oxidation of alcohol to acetic acid by the vinegar ferment, and that living organisms were involved in the production of nitrates from ammonia. Experimental proof of this idea was published by *Schloesing and Müntz* in 1877, and from this date all doubt ceased as to the biological nature of nitrification.

Schloesing and Müntz showed

(1) nitrification in a soil could be absolutely stopped by such an antiseptic as chloroform, which is known to have a powerful effect on living organisms

(2) a soil which has been deprived of its nitrifying properties by treatment with chloroform recovered them again on being inoculated with a small fragment of ordinary soil.

Warington extended these researches and published several valuable memoirs on the conditions affecting nitrification and the distribution of the active nitrifying agency in soil and water. Attempts to isolate specific organisms, however, were for many years abortive. *Munro* showed in 1886 that nitrification could take place in the entire absence of organic matter, and it gradually became apparent that the failure of all the early attempts to isolate the organisms of nitrification had been due to the use of nutritive media containing organic matter which was then supposed to be an essential food-material of all micro-organisms.

At this juncture the brilliant Russian physiologist, *Winogradsky*, undertook the investigation of the matter, and by new and ingenious methods was successful in isolating the nitrifying organisms and in cultivating them in the pure state. His medium for cultivation consisted of pure silica jelly, which was solidified by the addition of a minute proportion of the sulphates of potash, magnesia and ammonia and carbonate of soda. The exclusion of organic matter and the use of the solid jelly were the two secrets of his success in separating the

nitrifying organisms from the hosts of other micro-organisms which teem in ordinary fertile soil. The first organism thus isolated was only capable of oxidising ammonia to the state of nitrite, and was only responsible for the first stage of the process of nitrification. Winogradsky completed his discovery in 1891 by the isolation of a second type of organism which possessed the power of transforming the partially oxidised compound—the nitrite—into the fully oxidised product—nitrate.

The biological agents in this cycle of change had now been isolated and described, and nitrification was raised from the status of a mysterious and elusive phenomenon to that of a definite outcome of bacterial activity.

The Nitrifying Organisms.

Stage I. Conversion of Ammonia into a Nitrite.

The organisms responsible for this, the first stage in the general process of nitrification, belonging to the familiar class of minute vegetable organisms known as *bacteria.* Although several distinct species have been isolated which possess the power of converting ammonia into an alkaline nitrite under suitable conditions, they may be conveniently classified under the two groups (a) *nitrosomonas,* and (b) *nitrosococcus.*

Nitrosomonas.—This type is peculiar to the soils of the old world—Europe, Asia and Africa, and is distinguished as possessing marked powers of locomotion through the activity of a 'cilium' or long motile appendage. Only one species has so far been isolated from European soils and this appears in the form of minute, briskly motile cells provided with a 'tail' or flagellum. For bacteria, these organisms are of large size and vary from $\frac{1}{20,000}$ to $\frac{1}{40,000}$ of an inch in length and about two-thirds as much in breadth. If cultivated in a suitable liquid medium, the individual cells eventually become quiescent and undergo a distention of cell-wall which causes them to collect at the bottom of the liquid in adherent masses of a grey, gelatinous appearance. (Zoogloea).

Nitrosococcus.—Varieties of this type occur in South American and Australian soils and differ from the nitrosomonas class in two important features; (1) absence of cilia or organs of locomotion, (2) non-formation of gelatinous masses of zoogloea.

Distinct species of nitrosococcus from Quito and Brazil have been studied by Winogradsky and found possessed of exceptional vigour as producers of nitrite from ammonia. As the name implies, these organisms are spherical in shape. Their size is large as compared with many other bacteria and reaches $\frac{1}{12,000}$ of an inch in diameter in some cases

Stage II.—Conversion of Nitrite into Nitrate.

No organism of the class we have just considered has the power of extending the oxidation of ammonia beyond that of the nitrite, and a second distinct order of living workers is responsible for the final stage of the process of nitrification.

Nitrobacter is the term generally employed to describe the nitrate-producing bacteria which differ so markedly from the 'nitroso' or

nitrite-producing organisms. Nitrobacter are among the smallest of all known organisms being only one-tenth of the size of an average nitrosococcus. They exist as slender, pear-shaped cells, possessed of slow powers of increase in comparison with their capacity for nitrate-production.

If cultivated in a liquid medium they grow in the form of a thin scum which adheres persistently to the sides of the vessel.

Chemistry of Nitrification.

We are at present without knowledge as to the complete cycle of chemical changes which are brought about in the process of the nitrification of ammonia, and can only deal with the end-products of the vital activity of the nitrifying bacteria. We have already noted that the first stage of nitrification is the production of a nitrite by the agency of the "nitroso" organisms. So far as the mere process of oxidation is concerned, the following equation expresses the first stage of nitrification;—

Stage I.

$$2\,NH_3 + 3\,O_2 + Ca\,CO_3 = Ca\,(NO_2)_2 + CO_2 + 3\,H_2O$$

Ammonia + oxygen + chalk = calcium nitrite + carbonic acid gas + water.

This change goes on *only in the dark* and is independent of all organic matter. The bacteria themselves, however, contain protoplasm and the usual organic constituents of living organisms, and in order to obtain the carbon necessary for their growth and increase they avail themselves of carbonic acid gas. The separation of carbon from its union with oxygen in this gas requires the expenditure of a considerable amount of energy. Green plants obtain their supply of this requisite energy from the rays of the sun, but nitrifying bacteria live and work in the absence of such light and are unable to make use of this source of power. Winogradsky, as also Godlewski, have shown that the 'nitroso' bacteria obtain their energy for the elimination of carbon from carbonic acid gas by the supply they derive from the oxidation of ammonia to nitrite. The former experimenter concluded from his investigations that the 'nitroso' bacteria were able to assimilate one part of carbon for every 42 parts of ammonia oxidised to nitrite. It would therefore appear that the main vital object of nitrifying organisms is that of the assimilation of carbon from carbonic acid gas and that the nitrification of ammonia is simply a means to that end. The effective character of these agents of nitrification is apparent from the enormous amount of ammonia they are forced to oxidise in order to gain a small supply of vital carbon.

The chemistry of the conversion of nitrite into nitrate by the nitrobacter organisms is of the simplest.

Stage II.

$$Ca\,(NO_2)_2 + O_2 = Ca\,(NO_3)_2$$

nitrite of lime + oxygen = nitrate of lime.

It is necessary to draw attention at this point to a fallacy that is very constantly reproduced in current agricultural literature. It is often stated that ammonia is oxidised to nitric acid by nitrifying organisms and unless enough chalk to neutralise the acid be present, the organisms are destroyed or prevented from free activity.

It is clear from the work of Winogradsky that free nitric acid is not produced at any stage of the process, but that two stages of oxidation take place, (1) oxidation of ammonia to an alkaline nitrite, (2) complete oxidation of the nitrite to nitrate.

Unless oxygen (air), chalk, carbonic acid gas and a trace of such mineral foods as phosphates and potash be present, the necessary raw materials for nitrification are lacking and its progress impossible. It is certainly true that a salifiable base such as chalk is necessary for nitrification but it is a gross misrepresentation to state that this necessity lies in a need for the neutralisation of *free nitric acid*, which is perhaps the most corrosive substance that could be brought into contact with living organisms.

CONDITIONS AFFECTING THE NITRIFICATION OF AMMONIA.

A.—Presence of organisms.

Fortunately for the agriculturist, the bacteria responsible for nitrification are *universally distributed* and no practical cultivator runs risk of loss through the actual absence of nitrifying organisms. Cultivated soils from all sources, desert sand and rocky fragments from lofty mountain tops have all yielded proof of the presence of nitrifying bacteria Warington found that all the samples taken from the cultivated surface of the soil which he tested contained nitrifying organisms. At a depth of two feet, powers of nitrification were occasionally lacking, while at a depth of six feet and over the soil had lost all such powers. Nitrifying organisms, therefore, are mainly present in *the upper tilled surface* of the soil and do not exist in the lower depths of unstirred soil. Such a distribution is obviously due to the fact that conditions favourable for nitrification are alone possible in the upper surface of the soil.

B.—Air.

The atmosphere contains one fifth of its volume of oxygen gas and as this latter material is requisite for the purpose of oxidising ammonia, a full supply of air is necessary for the free progress of the change. Drainage, cultivation with plough and harrow, spade, fork and hoe are time-honoured tributes to this fundemental requirement of cultivated ground A water-logged soil in which the pores are saturated with water is an impossible medium for nitrification owing to the absence of air. The wonderful improvements that have been brought about in the case of stiff, impervious soils by drainage and good cultivation are closely associated with the improved aëration of the soil and the consequent promotion of nitrification.

C.—Presence of salifiable base.

Chalk. It is desirable that special emphasis be laid on the absolute necessity of such an alkaline carbonate as chalk for the general requirements of the process of nitrification Those traditions of good cultivation which have been evolved through centuries of experience and observation by generations of practical men, have received marked confirmation and a rational explanation through the latest discoveries as to the causes and conditions of nitrification. The recommendations of science, based upon a comprehension of the causes at work, are singularly in harmony with the general maxims of good cultivation, based upon a shrewd appreciation of obvious effects. Of all the conditions

favouring nitrification, lime or chalk is the one that is most frequently lacking in practice and that merits the careful consideration of every agriculturist who seeks to obtain the best returns from the cultivation and manuring of his land. Chalk is rapidly washed out of cultivated soil through the action of water and carbonic acid, and moreover it is an essential for the working of sulphate of ammonia at two stages of its history in the soil. First, chalk is required to convert the sulphate into carbonate of ammonia, and again when this ammonia is undergoing oxidation through the agency of the 'nitroso' bacteria, chalk (or under certain conditions magnesium or potassium carbonate in its place) is essential for the production of the nitrite.

It is difficult to draw a hard and fast line as to the minimum amount of chalk in a soil for the adequate nitrification of ammonia. From the theoretical point of view, an acre of loamy soil to a depth of 6 inches would lose about 95 lbs of lime (previously existing as carbonate) for each hundredweight of sulphate of ammonia applied to the soil. This spells a theoretical minimum of one part of lime in 20,000 parts of soil for the nitrification of 1 cwt. of sulphate of ammonia per acre. A soil containing such a small proportion of lime as this however, would be practically sterile, and it would appear that soils which prove capable of free nitrification and adequately respond to the application of a liberal manuring contain, as a rule, at least a hundred times this amount of lime (0·5 per cent.)

At the same time, there are hundreds of soils containing as little as 1 part in a thousand of lime (0.1 per cent.) in which ammonia or dung prove capable of normal nitrification.

The results of soil analyses are frequently misleading on this point, as the analyst often gives his results for the *total lime* in every form of combination in the soil and neglects to state the proportion of *lime as carbonate* which is alone of service in assisting the efficacy of sulphate of ammonia Many of the cases on record in which chemical fertilizers have failed to produce adequate results ha e been due to a deficiency of chalk in the soil. Such a failure would as inevitably follow the use of dung, guano, or dried blood and is the outcome of *a fundamental deficiency in soil fertility.*

In emphasizing the great necessity of chalk in the soil for the successful use of ammoniacal manure, we are but urging a matter of crucial importance as regards the general fertility of the soil.

Chalk is a necessary foundation of the fertility of the soil.

In its absence, sulphate of ammonia cannot be nitrified, dung and organic manures are incapable of normal results and acid phosphates or potash salts become ineffective or even injurious manurial applications.

The surprising results which have been obtained on many soils by the use of basic slag are largely due to its alkaline nature and the assistance it renders to the progress of nitrification in the soil.

Liming.—If lime be a necessity for the progress of nitrification, and its constant wasting from the soil a necessary result of cultural conditions, its addition to soils in need of it is clearly a matter of some moment. The practical solution of the lime problem is not as simple as it appears at first sight. Lime is itself a powerful and caustic sub-

stance and when dissolved in water imparts to it the pronounced alkaline properties of 'lime-water'. Warington and Winogradsky have each shown that concentrated lime water destroys the nitrifying bacteria, and that these organisms only flourish when their surroundings are feebly alkaline in character.

Many a farmer has found that the application of 3 or 4 tons of slaked lime per acre has had a depressing effect on the crop immediadiately following the application. So large a dressing as this applied in the spring of the year is practically certain to have a markedly injurious effect on the soil-bacteria and to prevent their free growth and activity until the alkalinity of the lime has been destroyed by the carbonic acid and vegetable acids derived from the humus of the soil. The following and subsequent seasons, however, will yield gratifying proof of the benefits of liming, provided the soil was one really in need of such treatment. It is rarely wise to apply more than a ton per acre at a time, and this is best applied in temperate climates in the winter when nitrification is practically suspended. Excellent results have followed the use of such moderate dressings as 6 or 8 cwt. per acre; the German Agricultural Society, for instance, found in their field experiments with sulphate of ammonia which were conducted at many different centres under the direction of Professor Maercker, that the application of half a ton of lime per acre to the soil before applying a dressing of sulphate of ammonia yielded an increased crop averaging *over 2 cwt. of corn in the case of barley and oats.**

Chalk or marl is often obtainable at small cost and although at least four times as much is required to equal the effect produced by lime, there is no risk of injury to the soil or crop.

D.—Moisture.

When soil is dust-dry, nitrification ceases. Schloesing found, for instance, that provided the soil was not water logged and free aëration was secured, the rate of nitrification increased with the proportion of moisture in the soil. In one series of experiments he obtained the following results :—

Per centage of moisture in soil	9.3	14.6	16.0	20.0
Pounds of nitric acid produced per acre in 13 months	157 lbs.	172	397	478

Generally speaking, nitrification is appreciable in a soil containing 4 per cent. of moisture, and is at its maximum when the soil contains about half the total quantity of moisture which it is capable of retaining.

From the point of view of practice, nitrification is thus seen to have a close connection with the accidental variations of season, other conditions being the same. A season of intermittent and fairly liberal rainfall is most favourable for nitrification. Excessive wetness, however, depresses this activity by reducing the temperature of the soil and overloading it with moisture. It is important to note that cultivation is of great service in promoting and maintaining the progress

* Jahrbuch der Deutschen Landw. Gesellschaft, 1889, p. 450.

of nitrification during a trying time of drought. The addition of dung and bulky organic manures greatly promote the water-holding properties of a soil, and the constant preservation of a loose surface tilth by the use of cultural implements prevents the free escape of soil-moisture into the air. It is clear that, after all, the water supply is a most crucial factor in the development of our crops, for not only does this limit the direct feeding capacity of the plant but also the rate of production of nutritive nitrates from the humus of the soil and such manures as sulphate of ammonia.

E.—Temperature

The most favourable temperature for nitrification is about 100°F., at which temperature Schloesing found it to be ten times as active as at 57°F. In hard frost the action entirely ceases, but, as Warington suggests, in an average English winter the change is generally going on to a small extent. In tropical climates which combine abundance of moisture with a brisk heat, great intensity of nitrification is assured and this is one of the explanations of the remarkable luxuriance of tropical vegetation.

Nitrification goes on both night and day in the soil, and the great advantage of warm nights in promoting this fermentation suggests an adequate explanation of the favourable effect of such conditions on vegetation.

The temperature of the soil is obviously a question of climate and season, although cultivation can modify it to a certain extent. Efficient drainage and good surface cultivation, each conduce to an economy of the heat of the soil, and thereby induce improved nitrification on this account.

F.—Cultivation.

Although nitrifying organisms are apparently ubiquitous, their rate of reproduction is relatively slow. A reclaimed soil which has been hitherto unproductive generally requires one or two seasons to develop normal intensity of nitrifying power. From the peculiar natural properties of the nitrobacter organisms, it would appear that constant stirring and turning of the soil should promote their uniform distribution and rapid increase in the soil, and experiments by Schloesing as to the rate of nitrification in soil under various conditions of cultivation favour this idea.

G.—Potash and Phosphates.

Both types of nitrifying bacteria require a general mixed diet of mineral food, besides the carbonic acid gas and ammonia which form their staple nourishment. Of these minerals, potash and phosphates are of the chief importance. It is thus evident that a well nourished soil not only feeds a crop directly, but by promoting nitrification of ammonia exercises a very important secondary action.

CONCLUSIONS.

(1) Sulphate of ammonia when applied to fertile soil gives up its acid to the chalk with which it comes in contact.

(2) The ammonia is then absorbed by the soil and prevented from loss by drainage owing to the guardianship of humus and clay.

(3) Ammonia is converted first into nitrite and finally into nitrate of lime by two distinct types of bacteria.

(4) The general conditions of soil-fertility are closely connected with those of nitrification, good cultivation promotes efficient nitrification.

(5) The rate of nitrification of ammonia corresponds with the requirements of plants and during the growing season this change takes place quite as fast as is good for the plant.

INSTRUCTIONS FOR THE USE OF CARBON BISULPHIDE AS AN INSECTICIDE.

By H. H. Cousins, M.A. (Oxon), F.C.S.

Introduction.

Carbon bisulphide is the most efficient insecticide known for the treatment of insects destructive of stored grains, root-boring pests in the soil and insects injurious to stored tobacco, clothing and books.

It is also of great value for the destruction of insects in granaries and houses where these have become a serious pest.

Owing to its high volatility and the extremely inflammable nature of its vapour, carbon bisulphide requires special precautions in its package for transit and its practical use. Owing to the unreasonable prejudice in carrying this article on the part of many railways and steamship companies it is a most difficult article to obtain in the tropics, and the small quantities offered by the retailers in Jamaica are sold at so high a price—as much as 3/6 per lb —that this valuable insecticide is out of the reach of the general public for use on any practical scale.

It seemed desirable, therefore, that the Government should facilitate the supply and distribution of carbon bisulphide for use as an insecticide, and through the action of the Chairman of the Board of Agriculture arrangements have been made for the importation and distribution of a trial consignment of this article under conditions most favourable to its use by the public

It was considered that carbon bisulphide required careful regulation and control under tropical conditions and that its importation, storage and distribution at cost price could be undertaken by the Island Chemist without unfairness to retailers or departing from the general policy of the Government.

A preliminary consignment has been received from England at a very favourable rate and of exceptional quality. This will pay the usual *ad valorem* duty and can be supplied to the public in special drums holding 100lbs., 10lbs. or 5lbs. each *at actual cost price.** Packed in a special manner, this bisulphide will be carried by freight trains on the Government Railway at the Chemist's risk. Arrangements have also been approved for storage and distribution from Government Petroleum Stores at different centres in the island. A supply of carbon bisulphide should, therefore, be obtainable in any part of Jamaica at the lowest possible cost and with the minimum of risk consistent with its safe storage and transit.

All applications and enquiries should be sent to the Island Chemist, Government Laboratory, Kingston.

* Price 4d. per lb.

Properties of Carbon Bisulphide.

Carbon bisulphide is a liquid one fourth heavier than water (specific gravity 1.29).

One gallon weighs nearly 13 lbs.

It is very volatile and evaporates rapidly when exposed to the air.

It is highly inflammable Its vapour when mixed with air is liable to explode when ignited.

It boils at 115° F. Its vapour is much heavier than air and always tends to flow downwards.

It is a compound of carbon and sulphur: 3 parts of carbon united with 16 parts of sulphur.

Its vapour possesses a sweetish smell when perfectly pure. The commercial article always has a more or less objectionable odour. It should not be inhaled in any quantity as it causes dizziness and palpitation of the heart. Fresh air is the best treatment in case of a person becoming affected by the vapours.

Rules for safe Storage and Handling.

1. Keep it in the special iron drums or, if in small quantity, in stoppered bottles. See that the stoppers are tight.
2. Store in a dark, cool place, preferably an outside store where fire or light will not have access to the liquid.
3. In pouring out a supply, take care that no flame nor even a lighted cigar or pipe of tobacco is near. Arrange to have the vapour as low as possible so as to avoid breathing it.

Warnings.

1. Do *not* expose the drums continuously to the heat of the sun.
2. Do *not* store in a place where the vapour could possibly catch fire.

With these precautions, which are obviously necessary from the nature of the substance, carbon bisulphide can be handled and used without any risk or danger.

Instructions for Use.

Insects in the soil.—For the destruction of root borers and ants, as well as for sterilising soil in which seeds or plants liable to injury from insects are to be raised, carbon bisulphide is an effectual agent.

1. Root Borers.—The liquid itself is destructive of any root brought into contact with it. The vapour, however, in regulated quantity is harmless to roots and highly destructive to insect life in the soil. Hot, dry, sandy soils should only be treated when they have been thoroughly moistened with rain or irrigation water. As a general rule, it is desirable in all cases to use carbon bisulphide when the soil is still damp, since its action is thereby better controlled and regulated. Bore holes at the rate of 4 per square yard to a depth of 12 inches. No hole should be within 18 inches of the tree-trunk. A quarter of an ounce of the liquid should be poured down each hole. Special appliances are sold for this purpose enabling two men to make 2,000 injections per diem. For occasional use, the holes should be made with a crow-bar and the liquid poured down an iron tube. The earth should be trampled over the hole after treatment. In some cases the holes should slope toward the tree trunk so as to reach insects under the central point.

2. Ants.—When the nest has been located, bore two or more holes to a depth of 1 to 2 feet in the centre of the nest and pour 2 ounces of bisulphide down each hole. Close the hole with earth immediately.

Borers in trees.—Where the sawdust and castings indicate an active borer at work, inject a little bisulphide with an oil-can into the hole and stop the opening with clay.

To sterilise soils for seedlings and delicate pot plants—Place the soil in a suitable box or tin with a close fitting lid. Pour on one ounce of bisulphide per bushel of soil, after two days, spread the soil out in the open air. All insect life in the soil will thus have been destroyed. This treatment is found not to injure in any way the fertility of the soil.

Stored Products.

To disinfect a granary.—Where large quantities of grain are stored in a building and serious losses through weevils and other insect pests occur, it is a great advantage to treat the whole building with carbon bisulphide.

To do this certain obvious precautions are necessary.

(1) The building must be made fairly tight. Ventilators must be papered over and doors made to shut close.

(2) Preparations must be made so that a number of men can enter the granary simultaneously, each to pour out in a prepared receptacle the requisite dose of bisulphide and then immediately to retire The building should then be kept close for 48 hours and all windows and doors opened for four hours before it is again occupied.

(3) Stringent precautions to preclude any chance of firing the inflammable vapour must be taken.

For every 25 square feet of floor space supply 1 square foot of evaporating surface (flat tins or dishes).

Each pan or dish should receive one pound of liquid. The dishes should be placed on level supports four feet from the ground. An entire store of grain could thus be freed of insects at one operation extending from Saturday to Monday.

To free grain from insects on a smaller scale.—Carbon bisulphide in the proportions here recommended will destroy insects in grain without affecting the germinating power of the seeds.

Every person who stores corn, peas or other grain subject to insect attacks, should prepare a fumigating box as follows :—

Obtain a barrel, puncheon or packing case of suitable size.

Line the inside with building paper stuck on with a mixture of varnish and whitening (chalk). Construct a lid which can be fastened down firmly on a bearing coated with felt. For every 50 cubic feet of space in the receptacle employ one ounce of bisulphide. For an ordinary flour barrel one teaspoon full ($\frac{1}{8}$ ounce) of bisulphide should suffice if the receptacle be tight and free from leaks.

Place the bisulphide in a saucer on the surface of the grain, and keep tightly closed for 36 hours.

Clothes Moths.—Great damage to clothes is done in the tropics by various species of clothes moths. Camphor and naphthalene or pyreth-

rum insect powder tends to keep the adult insects away, but the former, at any rate, have no effect on the larvae when they have once commenced their attack on the clothing.

Before putting clothing, woollens, or furs into store it is advisable to treat them with carbon bisulphide. An ordinary tin trunk can be used if newspapers are spread over the top and the lid kept tightly closed. Pour half a wine glass full of the liquid on the surface of the clothing, spread the papers quickly and shut tight. Should the box be opened at intervals afterwards, naphthalene balls or insect powder serve to keep away a fresh infection. The liquid will not injure the clothing nor leave any stain.

Household Insects.—Should it be desired to destroy cockroaches, bed bugs or fleas in a house, it should be treated on the lines laid down for disinfecting a granary, (page 11)

A suitable time for this treatment would be an occasion when the house is to be shut up for three or four days or longer. Individual rooms could be treated, if desirable. Stringent precautions to avoid ignition of the vapours or their inhalation by human beings are of course necessary.

Insects in Tobacco, Museum Specimens and Books can be readily destroyed by treatment in a suitable closed vessel with carbon bisulphide. If the receptacle be tight, one ounce of bisulphide will suffice for each 50 cubic feet of space. The treatment should last for 36 hours.

Authorities utilised

Carbon bisulphide as an Insecticide by W. E. Hinds.
Farmers Bulletin, 145 U. S. Dept. of Agriculture.
Insects affecting Tobacco by L. O. Howard.
Farmers Bulletin 120 U. S. Dept. of Agriculture.
Household Insects of the U.S.A., by F H. Chillenden.
Chemistry of the Garden by H. H. Cousins.
Macmillan & Co., Ltd.

THE EUCALYPTS IN SOUTH AFRICA.*

There are probably more Eucalypt plantations in South Africa than in any other country, and at the present rate of progress there will in a few years, be more Eucalypt plantations in South Africa than in all the other countries combined. There is no group of trees in the warm temperate regions of the world that can produce hardwoods of good quality so rapidly and so cheaply as Eucalypts, and their cultivation bids fair to become the central factor in the forestry of these regions. At this moment train-loads of Eucalypt timber are pouring into South Africa, Eucalypt sleepers displacing metal and creosoted-pine sleepers. South Africa will soon be paying out something like a *quarter of a million pounds yearly* for Eucalypt timber imported for railway sleepers and mining timber (little or none of this, by the way, E. Globulus) so that any delay in the prosecution of Eucalypt planting in South Africa would be a most expensive proceeding. It is noteworthy that, so long as the Eucalypt is properly suited to the climate, it seems to grow better in South Africa than in Australia, the expla-

* From letter in *Nature*, 6 Aug., 1903, by D. E. & E. Hutchins.

nation being probably that all the Eucalypts in South Africa have been raised from seed, and are thus growing in South Africa free from their Australian pests, both fungoid and insect. With the view of preserving this happy immunity from disease, the importation of Eucalypt plants into Cape Colony is placed under stringent restrictions.

MORINGA.

PAPER ON THE OIL OF "BEN," FROM THE MORINGA PTERYGOSPERMA.*

Read by H. J. KEMBLE, Esq., to the Branch Society of Arts, Jamaica, 31st December, 1854.

The Oil now exhibited was prepared from the seeds of the Moringa pterygosperma, some of which accompany this specimen.

My attention was first called to the value of this production by perusal of a copy of a petition to be found in the Votes of the Hon. House of Assembly. vol. 13, page 145, which was inserted in one of the public papers, (No. 1, below.) More particular and scientific descriptions of the tree, and of the virtues and value of the Oil, may be found in the Pharmaceutical Journal, vol. 5, page 58, (No. 2); and in "United States Dispensary," Wood and Bache,) page 1359, (No 3.)

I was also favoured by Dr. Bowerbank with a copy of a letter on the subject, written in April, 1851, to a member of the Legislature, by the late Mr. Robert Smith.

Having satisfied myself that the only *effectual* machine for the expression of vegetable oils, was the Hydraulic Press, and that there was such a machine at the Railway Station in Kingston, I applied to Mr. David Smith, and by him was very kindly offered the use of the press, and every facility for the experiment. I then procured some horsehair bags, and caused to be manufactured, a large tin tray or dish, with sides sloping to a small well in the centre. Having next procured several lbs. of the seeds, shelled, and divested of the inner winged husk, I placed 2lbs. of such seeds in one of the horse hair bags and suspended it over the tin tray or dish, between two plates of iron, operated upon by a *screw press* as the hydraulic press proved to be out of order, and consequently useless. This (screw) press was worked with long levers, by six powerful men. The pressure was necessarily imperfect, and its inadequacy was increased by the press being horizontal instead of vertical. This occasioned the necessity of suspending the bags, by which the seeds were precipitated in a mass to the bottom and the pressure applied to that mass, instead of acting on each individual seed. The product, nevertheless, was an ounce and a half of oil to a pound of seeds, and I entertain no doubt that with adequate pressure Dr Nicholas Van Echout's statements of the yield (2 oz. to the lb.) would be fully supported.

I subsequently subjected 6lbs. weight of seeds to the same pressure, with the same result, and, in proof of the imperfect nature of the pressure employed, may state that a considerable quantity of the oil

* Transactions of the Jamaica Society of Arts Dec. 1854, to Dec. 1855, inclusive. Vol. I. Kingston, Jamaica.

was subsequently obtained by submitting the oil-cake or residuum, to further pressure, and by boiling.

I forwarded a keg of the seeds, in the husk, to London, in September last, and another keg to New York, and I subsequently sent three ounces of the oil to each of those cities with directions to ascertain and report to me the marketable value in those places, and the machinery best adapted to its manufacture. I have had a partial notice of my shipment, from London. That notice, however, although only applicable to the *seeds*, is of some value (No 4.)

I have directed the *oil*, since forwarded to London, to be submitted to Professor Johnston, for analysis.

Independly of its not turning rancid, this oil is said to be free from salt, and therefore, as well as from its limpid character, to be valuable to watch-makers, gun-smiths, and for all kinds of machinery. I have had it tested on brass, at two of the watch-making establishments in Kingston, and it has been reported to me as equal to the "watch oil" which they import at a cost of 2s. 6d. for a bottle the size of a man's little finger. Some of the oil expressed from the refuse of my experiments at the Railway has since been used with advantage for the oiling of the Railway clock, and has been found superior to the oil previously used, all of which had a tendency to coagulate and clog the machinery, unknown to the limpid character of this oil.

For the purposes of the watch-maker, and machinery, the demand for this oil might not be sufficiently great to be remunerative, but a reference to the following Table will show that it might be cultivated and sold at a price which would enable it to compete with any of the oils now used for domestic purposes, and as its culture appears to be attended with so little difficulty and expense, while it is affected by none of the casualities arising from drought and otherwise, to which other species of cultivation is liable, it is to be hoped that it will, ere long, take its stand among the staples of the island

Number of Trees in one acre	...	1,320
Giving 3lbs. seed a Tree	...	3,960
Ozs. of Oil at 2 ozs. to each 1lb. seed	...	7,920
Gallons Oil at 160 ozs to gallon	...	49 gals. 80 ozs.
Value at 8s. per gallon	...	£19 16 0
Or say 100 acres	...	£1,980 0 0

I have said but little as to the cost of culture or manufacture, because the cultivation would be very similar to that of Coffee, and the above calculation leaves a very large margin for expenses. I have allowed but 3lbs. of seed per tree, whereas it is said to give *ten* lbs per tree—and but 8s. per gallon for the oil, whereas it would seem to be worth two or three times that amount. The cost of a hydraulic press would be about £150, and a machine for taking off the winged husk, and winnowing the chaff, could not be expensive.

I have tried this oil as a burning oil, on a small scale, and nothing could surpass the clearness and brightness of the flame, and total absence of all disagreeable odour even when blown out.

No. 1.—*Votes, Vol. 13, Page 145.*
58th Geo. 3rd. 19th November, 1817.

A petition of Nicholas C. Van Echout was presented to the House, and read, setting forth :

That the Marengo plant grows equally well on the poorest or richest soil, on rocks where scarcely any mould is perceptible, and even on walls, and is so little affected by the sun or drought that it produces seed the whole year.

That the plant might be cultivated in dry situations, or barren soil, such as the pens in Liguanea.

That seeds of six trees of three years old, raised in very barren soil, yielded 3 lbs of seed each, when cleaned of the husk, and yielded 2 ozs. of oil, or 36 ozs. from six trees ; this oil too has been used in salads, and for culinary purposes, and found equal to the best Florence oil in lamps, and as clear light as spermaceti, without smoke ;—it does not get rancid by age, or acquire any disagreeable scent, and has made soap resembling Windsor Soap.

The seed should be planted at six inches distance, and may be transplanted in a year. The trees should be planted in rows of two feet and a space between sufficient for a cart, when gathering the seed. The third or fourth year the trees may be thinned, and if topped at the proper season, they will produce 10 lbs. of seed in a year. The branches, if planted in seasonable weather, will thrive and bear seed in the course of a year ; six hundred and sixty feet by sixty-six feet divided into allies of eight feet, and the trees at four feet in the row, give one thousand three hundred and twenty trees—every tree will produce 6 ozs of oil, which at 90 ozs. to a gallon, is 88 gallons per acre—the oil at 13s. 4d. per gallon, one hundred acres would produce £5,866 ; allowing £2,000 for contingencies, there remain £3,866 net profit.

Guinea grass may be planted under these trees to great advantage ; swine are remarkably fond of the seed ; and in dry weather the leaves and young branches are as useful for feeding b asts as the bastard cedar ; the husk of the seed, after extracting the oil, fattens pigs and poultry, by adding to every ten gallons of the husks, one gallon of molasses.

A varnish mixed with the gum of the Marengo gives the most brilliant lustre to furniture ; £200 would furnish manufacturing materials for a plantation of one hundred acres ; the ashes yield potash sufficient to make soap with the residue of the oil which has been refined. The machines are, for pulping the seeds, for winnowing the chaff, and for expressing the oil, all of which may be made by a common carpenter, and the expense will not exceed £50.

And praying the encouragement of the House, &c. Ordered, that the above petition do lie on the table.

No. 2—*Pharmaceutical Journal, Vol. 5 page 58.*
On the Moringa pterygosperma, or Oil of Ben Tree.
By William Hamilton, M.B.

The Moringa pterygosperma, or horseradish-tree, although not a native of the West Indies, is now perfectly naturalised there, and merits attention both for its economical and pharmaceutical properties.

On removing the winged envelope, the seeds appear somewhat like

pith-balls; but upon dividing them with the nail, they are found to abound in a clear, colourless, tasteless, scentless oil, of which the proportion is so large that it may be expressed from good fresh seeds by the simple pressure of the nail. Geoffry informs us that he obtained $30\frac{1}{2}$ ozs of oil from 8 lbs. decorticated seeds, being at the rate of very nearly 24 lbs. of oil from 100 lbs. of seeds. The oil thus obtained, is the celebrated oil of Ben, or Behen. which at one period, constituted a valuable branch of commerce with the East until excessive imposts and extensive adulteration brought it into unmerited disrepute.

The Moringa-tree, as we learn from Dr. Broughton's catalogue of East's garden, inserted in the 3rd vol. of Edward's History of the West Indies, was introduced into Jamaica from the East Indies in the year 1784, and most probably found its way into the other islands about the same time. Yet, though thus established for the best part of three quarters of a century among our planters, notwithstanding the great value of its oil, and the facility with which it can be obtained, the moringa-tree has been hitherto valued merely as an ornamental shrub, and cultivated, for the sake of its young pods, or the horse-radish of its roots as luxuries for the table

The oil which is so profusely obtained from the seeds is peculiarly valuable for the formation of ointments, from its capability of being kept for almost any length of time without entering into combination with oxygen. This property, together with the total absence of colour, smell, and taste, peculiarly adapts it for the purposes of the perfumer, who is able to make it the medium for arresting the flight of those highly volatile particles of essential oil, which constitute the aroma of many of the most odoriferous flowers, and cannot be obtained, by any other means, in a concentrated and permanent form.

No 3.—*On the Oil of Ben.*

From United States Dispensary. (Wood & Bache.)

This is a fixed Oil extracted from the seeds of the *Moringa pterygosperma* and *M. aptera* of Gaertner, confounded by Linnæus under the name of *Guilandina Moringa. Hyperanthera Moringa* (Vahl) is a synonym of the former species. These are trees belonging to the family of Leguminosæ, inhabiting different parts of India, Arabia, Syria, &c., and introduced into the West Indies. The leaves and other parts have an acrid property, which has probably given the name of *horse-radish tree* to the Moringa pterygosperma. The oil of the seeds has long been known, though used rather in the arts than in medicine. Most of it is prepared in Europe from seeds brought from Europe, (Merat and de Leus,) but it is also said to be extracted in the West Indies. It is inodorous, clear, and nearly colourless, and keeps long without becoming rancid. It is employed for similar purposes as olive oil. According to Völker the oil contains margerin, olein, and a peculiar fatty matter yielding a peculiar acid by saponification which he proposes to call *benic acid. Journal de Pharm, et de Chim.* xiii. 77.

No. 4.—*Extract from a letter from a London Merchant in reference to the Moringa Seeds..*

"Mr. Kemble has sent home a sample of oil-seeds. I have shown it to some brokers in that way, and have a sample now in their hands

for the purpose of having a report upon it. They do not know it—but from a casual inspection of it they expressed themselves favourably about it.

In fact, now-a-days, anything that produces vegetable oils will *sell*, indeed oil-seeds are equally sought after, and it is merely a question of cost of production and putting down here. The husk on the seed is much against it, and it would save freight, and increase the value much, commercially, if it could be taken off."

Extracts from a Paper on "Oils & Fats."

By Leopold Field, F.R.S.C., F.C.S., in Reports of the Colonial Sections of the Exhibition (Colonial and Indian Exhibition, 1886.)

Ben, or more properly *Behen Oil* was exhibited by the Botanical Department, Jamaica. This exquisite oil, which nature would appear to have devised expressely for the perfumer, seems to be singularly neglected. At least, the writer's efforts to obtain a genuine sample have hitherto proved unsuccessful. Mr. Septimus Piesse, in his excellent little work published in 1862,* grows quite enthusiastic over this oil; as embodying the highest desiderata of the craft: freedom from all odour, tendency to grow rancid, or to solidify.

These assertions are borne out by all who write upon this subject. The sample submitted was exposed in thin layers to warm air currents for a week, without exhibiting the faintest tendency to grow rancid. Hence the oil of Behen would be (perhaps is) invaluable to the "enfleurageur" who has perpetually to combat the tendency to rancidity in even the finest lards.

It is stated that "Macassar oil" is made on a Behen basis. This being the case, it is singular that the material should never appear on the market or be offered for sale. After repeated application to Grasse, Cannes, a sample was reported as shipped. This however, to the intense chagrin of the recipient, proved to be Benné or Sesame oil, also a beautiful product, but not equal to Behen.

Jamaica, through Mr. Scharschmidt, proved her capability of doing great things in enfleurage, some very fine (although slightly rancid) jasmin and tuberose pomades being shown. Hence it may be hoped that the *Moringa pterygosperma*, or better still *aptera*, will receive the cultivation it deserves, in a country where the oil can be utilized to the fullest extent. The amount of flower-pomades and oils consumed in England alone is enormous, and the whole supply is drawn from France. There is no duty on these goods. Why should our own Colonies not supply us? Why should all our citron, bergamot and orange oils come from Messina and Spain, when the West Indies can grow these fruits in any quantity? These questions are such as arise in the mind of one deeply and patriotically interested in perfumery, without special knowledge of the particular conditions obtaining in the localities addressed.

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* Art of Perfumery. London: Longmans Green & Co., 1862.

THE COTTON WORM.*

The life of the cotton worm is divided into four distinct periods or stages, which always occur in the same order. There can be no change of sequence and it is impossible for any stage to be left out. The four stages are the egg, the larva, the pupa and the adult.

While the egg of this insect is small and perhaps not commonly known, yet every one knows the nature and function of an egg, and in these respects the cotton worm egg is like all other. It is small, rounded, greenish in colour, and when seen with a lens shows fine radiating lines upon its upper surface,

The eggs are laid on the under surface of the cotton leaf and are scattered about, not in clusters.

The larva is more commonly called the caterpillar or worm. The last of these names is incorrect, because the caterpillar of a moth or butterfly is in no sense a worm. The name cotton worm has, however, became so well established that it seems advisable to retain it rather than to attempt to change it, thereby perhaps creating great confusion.

The skin of a caterpillar is not capable of much growth after it once becomes hardened. In order, therefore, to increase its size to the full, it is necessary for the animal to shed its skin several times, each new skin being much larger than the preceding. The new skin is already developed under the old one, and is very soft but soon becomes distended and firm. At the last of these 'moults' or changes of the skin, instead of another caterpillar skin, a dark-brown thick covering is developed, the body is much shortened and the pupa or chrysalis appears.

Some insects roll up leaves or spin silken cocoons previous to the last moult in which to pass the pupal period. The cotton worm generally ties over merely an edge of the leaf, though sometimes, if suitable cover is not at hand, the pupa is formed almost without cover

In the pupa stage the wings, mouth-parts and antennæ of the adult are developed, the reproductive organs being perfected from mere rudimentary forms. At this time the insect does not feed and has no power to move from place to place, its only power of motion being a wriggling or twisting movement, which is frequently noticed when the pupa is disturbed.

When the necessary changes have taken place within the dark-brown pupa skin, it breaks open and the adult insect crawls out At first its wings are very small but they quickly spread out, and in a very short time the small, olive-grey moth is dry, its wings strong and it is able to fly. The caterpillar has strong biting jaws and it swallows its food in solid particles, but in the moth the mouth-parts are so changed that no jaws are to be seen, but instead a long slender thread-like proboscis, by means of which it sucks up the nectar from flowers.

In this stage the insect does no damage to the cotton plant, merely sucking up enough of the nectar from the flowers and the nectar glands of the leaf to keep itself alive while performing the reproductive func-

* Communicated by the Imperial Department of Agriculture for the West Indies.

tions of mating and laying eggs. These moths are called "dusk-flies" because they fly only in late afternoon and early evening. Each female deposits 300 to 500 eggs, taking probably a week or ten days in which to do it.

Remedy.

Reprint from the *Agricultural News* Vol. II., p. 362.

In a previous number of the *Agricultural News* (Vol. II., p. 330), the use of Paris green as a dry mixture with finely sifted dry, air-slaked lime has been recommended. The dry mixture has been the more strongly advocated because it requires no expensive apparatus for its application and because there are so few spraying outfits in these islands. While the cotton worm occurred only sparingly, as was the case at the beginning of the season, 1 lb of Paris green in 50 to 100lbs of dry lime seemed to be sufficient, but now that every field attacked soon comes to have enormous numbers of caterpillars, this mixture is found to be too dilute.

Recent trials of a mixture at the rate of 1 to 10 seem to give good results; while the Hon'ble F. Watts and Mr. W. N. Sands write that in Antigua the mixture is most successfully used at the rate of 1 to 6.

The amount necessary per acre varies, of course, according to the size of the plants, but in Antigua 1 lb of Paris green has been found to serve for one application for ½ to 1 acre. An experiment, conducted at the Botanic Station, Barbados, has indicated that mixed in the proportion of 1 to 10, a pound of Paris green will be sufficient to dust ⅓ to ½ acre.

Used as a spray, Paris green has been recommended in a mixture at the rate of 1 lb to 150 gallons of water with two or three times its own weight of lime. This mixture may be made stronger —1 lb to 100 gallons of water —if a proportionate increase in the amount of lime be made. In preparing a Paris green mixture for spraving, the poison should first be mixed with a small quantity of water and then added the full amount, otherwise there is a possibility of its not getting thoroughly mixed.

AGRICULTURAL COLLEGE AT GUELPH.

The Agricultural College at Guelph, Canada, has a two years' course intended specially as a preparation for work and life on the farm. This course is the most important feature of the College as its design is to lay a scientific foundation on which the young farmers of the country may build up their practice, when working their own farms. The scientific basis is partly theoretical and partly practical. The practical side is considered all important; the scientific teaching throws light on the other, gives a rational explanation of operations, and teaches the youths to observe and to reason from their observations. Manual training in ordinary farm operations, such as harnessing and driving horses, ploughing, harrowing, &c., must be learnt before admission to the College and a certificate must be produced that at least one year has been spent at work on a farm. Having ensured that a youth is

capable of hard work and has done it, the College authorities take care that the bent of the mind and interest in farm work is maintained and increased. An Apprenticeship Course must be taken at the same time as the Course of Study, and every alternate afternoon and some mornings are entirely devoted to work in the outside departments, of which there are seven, viz., Farm, Live Stock, Dairy, Poultry, Horticultural, Mechanical and Experimental. The students are sent in rotation to these departments, and are required to take their turn at a variety of jobs, clean and dirty, easy and difficult—whatever is to be done—without favour or distinction. In addition to this provision for making practical application of all the scientific studies that are taken in the class-room and laboratory, the students spend the summer at their own homes, helping their fathers in the farm work at the busiest time of the year.

Those who have gone through this two years' training to the satisfaction of the College authorities, and wish to pursue their studies further, can take another two years' course,* at the termination of which time the University of Toronto examines them and confers the title of Bachelor of the Science of Agriculture (B.S.A.)

The third year's course is the same for all,—English, French or German, Physics, Chemistry, Geology, Botany, Entomology and Nature Study. During the fourth year the Students specialize, choosing a particular branch from amongst the following:—Agriculture, Dairy, Horticulture, Biology, Bacteriology, Physics and Chemistry.

However, before admission to the Course for the *Dairy Option* candidates must present satisfactory evidence of having spent one season at practical work in a cheese factory and one in a creamery, or have spent one season in a cheese factory and have taken the full course (cheese and butter) in a Dairy School; those entering for the *Agriculture Option* must have spent at least two years at practical work with a good farmer; those entering for the *Horticultural Option* must have spent at least one year at practical work with a good fruit-grower, market gardener, or florist.

A record is kept of each student's practical work throughout the course Each student is required to prepare a Thesis on some branch or department of the work in his special course. It must be based chiefly on original investigation.

Equipment for Work.

The large amount of practical work and instruction in, or in connection with, the outside departments has an important bearing on the work and life of those who intend to follow agricultural pursuits. Hence, among the appliances possessed by the College for giving young men a practical education and fitting them for the life on the farm, we may refer to the equipment in some of the departments, and also to the Library and Reading Room.

Farm.

The farm proper of 345 acres is in good shape, well tilled and well managed, under the control of a good farmer.

*Or, a one-year's course for a Certificate in Agriculture or Horticulture.

Experiments.

Forty-three acres of the 550 owned by the College have been laid out in small plots; and a series of experiments with cereals, roots, grasses, manures, and various modes of cultivation and management, is regularly and systematically carried on from year to year. Besides the field experiments, others in the feeding of live stock are made, to test the several breeds of animals and the comparative values of different kinds of feed.

Live Stock.

The equipment in live stock is also fairly good. There are seven breeds of cattle, four of sheep, and three of swine, kept from year to year, that the students may acquire a broad and thoroughly practical knowledge of this important branch of farming; and to this end, are provided not only the animals, but also a special class-room and a live-stock pavilion for practical demonstrations in the handling and judging of cattle, sheep and swine. Practical work in these rooms is carried on by the Professor of Agriculture and his Assistant systematically throughout the fall and winter terms, and at such other times as may be necessary.

Carpenter Shop.

There is a large carpenter shop, provided with benches and tools for plain work and general repairs In this shop students are taught the use of carpenter's tools, and are shown how to do such work as is commonly needed on a farm. Under this head, they may learn many things that will be of use to them in after life.

Veterinary Department.

This department is furnished with a skeleton of a horse and a full supply of the bones of ordinary farm animals for illustration of the veterinary lectures; and the live-stock class-room is used by the veterinary surgeon for demonstrations in "practical horse," that is, for handling horses in the presence of the class, judging them by points, examining them as to soundness and freedom from blemishes, administering medicine, and showing students how to perform various surgical operations, &c. A large amount of valuable work on these lines is done every year; and when an animal dies from disease or injury, it is dissected and the cause or causes of death sought for and pointed out in the presence of the students.

Poultry

In the Poultry Department there are good buildings and yards, constructed according to the most approved plans and furnished with incubators, brooders, and everything else required for convenience and efficient work in the management of poultry. The stock in the building consists of 25 varieties of hens, representing 15 or 16 breeds, which are kept for breeding, for illustrating the lectures on poultry, and for practical instruction of the students sent to the department from day to day.

The Dairy.

The Dairy Department is fully equipped with men, buildings, and appliances for giving instruction in milk-testing, butter-making,

cheese-making, the running of cream separators, and the pasteurization of milk. Nothing is lacking that is necessary to give the broadest and most thorough training in every branch of the dairy business on a large scale suited to factory and creamery men, and on a small scale adapted to the circumstances of those who may have to handle milk or cream and make butter on the farm.

Apiculture.

An experienced apiculturist lectures on bee-keeping throughout the Fall Term, illustrating his lectures by appliances in the class-room and by the use of colonies of bees brought here for the purpose.

Horticultural Department.

In this department there is a large laboratory, with a complete set of green-houses, a six-acre kitchen garden, a vinery, a plot of small fruits, a thirty-acre lawn, an arboretum, a large variety of fruit and ornamental trees—everything necessary for first-class work in Botany and Horticulture.

Library and Reading Room.

The Library contains over 12,000 volumes on the different subjects embraced in the course of study; also a good selection of history, poetry, biography, and travels, and some fiction by a few of the best authors. The card catalogue system is used in the library, giving satisfactory reference, not only to authors and subjects, but also to articles indexed from the reports of the leading agricultural and scientific societies of the old world. A card indexed catalogue of all the reports and bulletins of the U. S. agricultural experiment stations is also placed in the Library.

The College Reading Rooms are furnished with from 60 to 70 of the leading papers and periodicals on agriculture, dairying, horticulture, poultry, apiculture, and scientific subjects; and a number of magazines provided by the Literary Society are also kept on file.

Advantages of the Course.

From the outlines given above, it is clear that the course of study and apprenticeship is especially adapted to the wants of young men who intend to be farmers. It includes what they require and nothing more. The lectures in the class-room, the work in the outside departments and the laboratories of the institution, the experimental work, the debates in the College Literary Society, the surroundings, the atmosphere of the College life, all tend to awaken, stimulate, develop, and brighten the students; to teach them the use of their eyes and hands, give them a taste for reading, increase their respect for farmers and farming, and make them more intelligent workers and better citizens.

BOARD OF AGRICULTURE.

A Meeting of the Board of Agriculture was held at Head Quarter House on Tuesday, 15th December, at 9 o'clock a m. Present: the Hon. Colonial Secretaryin the chair, His Grace the Archbishop, the Hon. Director of Public Gardens, the Island Chemist, Messrs C. A T. Fursdon, C. E. de Mercado and John Barclay, the Secretary.

The Secretary read the Minutes of the last Meeting which were confirmed.

The Chairman read a Minute regarding the position and emoluments of the Chemist, a letter from Mr. Cousins on the subject, and a memorandum from the Colonial Secretary to the Governor. It was resolved to recommend that the Chemist be offered £600 a year, be placed on the fixed establishment and given a personal allowance of £250 per annum in lieu of pensionable interest.

After considerable discussion on the subject it was resolved by the Board to express the opinion that it was necessary to have a Director of Agriculture, as soon as possible, as a general head of all agricultural work.

With reference to the Imperial grant of £10,000 it was acknowledged that this could only be used for the benefit of the Sugar Industry but a decision as to the exact manner in which it was to be utilized was postponed for further consideration.

The following Committee was appointed: Mr. C. A. T. Fursdon, the Island Chemist, Hon. J. V. Calder, and Hon. Sydney Olivier, the chairman, to report on a site for an Experiment Station and Stock Farm.

The state of the Parade Gardens having been brought before the Board, it was agreed to recommend a special vote of £35 for improving the water supply, and for reforming the paths.

The Director of Public Gardens having represented that it would be necessary to give up that portion of Castleton Gardens lying between the Main Road and the Wag Water and devote the whole of the funds to the remainder, the reduced grant allowed being found insufficient for the whole, it was resolved to recommend an addition to the annual grant of £25.

Mr. C. A. T. Fursdon asked if some representation from the Board could not be sent to the Director of the Railway to provide a better system for the landing of cattle from the Cattle Docks, as at present owing to the inconvenience and danger of the landing, cattle owners preferred to send their stock round by the road It was agreed to do this.

A letter from Mr. C L. A. Rennalls, teacher, Mavis Bank, asking the Board for a grant towards the better fencing of the School Garden there, was submitted and the Secretary was instructed to reply that there were no funds available for the purpose.

A Minute from the Director of Public Gardens suggesting the reappointment of the former Committee of the Experiment Station which had been circulated for the comments of the Board was submitted. It was resolved to let the matter remain as at present.

It was agreed that in consideration of the use of grass and

pasture on the Laboratory grounds, Mr. Cousins should keep the place clean.

A communication from the Hon. J. V. Calder on the subject of Horse-breeding in Jamaica which had been sent to the Secretary of State for the Colonies, who had referred it to the local Government, was read and on the motion of the Archbishop, seconded by Mr. Fursdon, was referred to the Agricultural Society for consideration.

The Chemist submitted a memorandum regarding an Agricultural Library and the matter was deferred to be brought up later.

The Chemist also submitted memoranda: (1) Cotton—it was reported that Upland Cotton grown at Mesopatamia Estate was a failure and that the Sea Island was doing well; (2) On the Horse Show, asking if he would be allowed to devote some personal effort to help it and also to utilize some of the odd time of the apprentices to help him if necessary; this was agreed to; (3) Report on grass oils which showed the ordinary native Lemon Grass to yield oil 5 times in value that from the Ceylon grass per ton.

The Director of Public Gardens submitted (1) Report on Hope Experiment Station, which was directed to be circulated among the members. (2) Cost of repairs and improvement of Tobacco curing house amounted to £8 9s. 4d, which expenditure was approved. (3) Memorandum re Cane cultivation at Hope, showing the cost of an additional 4½ acres as recommended by the Chemist to be £22 2s. 4d. It was decided to approve of provision being made for the increase in Cane cultivation at Hope, as suggested.

His Grace the Archbishop spoke of some matters that had been brought before him during his stay in the United Kingdom and the United States (1) On the desirability of making a registration of brands for oranges compulsory. (2) The carriage of Pine Apples to England. (3) Canning of Pine Apples—he desired the consideration of the members of the Board on these matters. (4) The desirability of having cards for use in schools dealing with primary agricultural matters, such as careful picking and handling of fruit

It was resolved to announce that the Board of Agriculture would offer a limited number of premiums of £5 for an experimental acre of Cotton in certain districts.

The Secretary submitted a Minute on the Importation of San Blas Coco-nuts. It was resolved to refer the matter to the Agricultural Society asking them to take over the matter and authorize their Secretary to deal with it.

The Director of Public Gardens reported that Mr. W. J. Thompson, Travelling Instructor, was at Longville taking statistics in the matter of the Cassava Starch Industry.

It was resolved for the convenience of members to alter the hour of Meetings from 9 a.m. to 11.15 a.m.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. FEBRUARY, 1904. Part 2.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. FEBRUARY, 1904. Part 2.

COTTON.

A Conference on Cotton was held at the Institute, Kingston, on the 12th November, and Sir D. Morris, who was on his way back from the United States, kindly gave an address embodying in its short comp ss the information that he had been able to acquire in his travels through the Sea Island Cotton districts.

On Sir D. Morris's arrival in Barbados, a Cotton Conference was held on 11th Dec, for the purpose of learning the results of his visit to the States, and his address, containing fuller information is published below.

It will interest many to have a statement of actual expenditure for the cultivation of cotton in Jamaica in the year 1842, and this is reprinted from the "Votes of the House of Assembly."

Instructions for planting cotton are added.

Cotton Conference.*

Sir Daniel Morris said:—This meeting has been called a conference because I prefer to meet the planters in conference for the mutual exchange of ideas and of information with regard to the matter that we have in hand. As you are aware, ever since the Imperial Department of Agriculture was established in the West Indies the desire of every member of that department has been to come into close contact with the planters in all parts of the West Indies We wish to work in harmony and sympathy with those gentlemen, and we are glad to have an opportunity like the present, when we can obtain their views and ideas, and ascertain what are the particular difficulties they have to contend with. We fully realise that in every department of agriculture there are numerous difficulties that have to be overcome or else we cannot reap the fruits of our labours. Now with regard to the question of establishing a

COTTON INDUSTRY.

The first time I brought the matter before the planting community in the West Indies was at a meeting held in Barbados in February

*The Barbados Advocate, 19th December, 1903.

last. I then gave as much information as I possibly could and promised to give all the assistance in my power. In response a large number of planters have taken up the cultivation of cotton and done the very best they could under trying circumstances to make the experiment a success. When we had decided that the Sea Island cotton was the particular variety suitable for cultivation, I obtained permission from the Secretary of State for the Colonies to pay a visit to the Sea Island cotton districts of the southern United States, in order to place the planters in as favourable a position as possible. The Secretary of State for the Colonies also gave permission for Mr. Bovell to accompany me in order that he might obtain at first hand all possible information as regards the industry so as to be able to help local cotton growers in any difficulties that they would have to contend with.

Trip to the United States.

We left for the United States about the middle of September last. We spent some time in New York making enquiries about molasses, and then we found our way to the Sea Islands. We were most kindly received there by the planters who took us over their plantations and ginning houses, and gave us all possible information about the industry. We were also accompanied by an officer of the United States Department of Agriculture who took us over certain estates, and experiments carried on by the department. I hope it is understood that I am not going to speak about the general cotton belt of the southern States of America but about

SEA ISLAND COTTON

The Sea Island cotton is confined practically to three States, South Carolina, Georgia and parts of Florida. That cotton was first obtained from the West Indies, and was obtained by a Governor of South Carolina, and has since been cultivated in that State and also in the two other States I have mentioned with great success. Under the stress of circumstances in the West Indies we are anxious to obtain another industry, and one industry that we are trying to establish is that of Sea Island cotton. In order to thoroughly understand the circumstances of that industry we cannot have a better object-lesson than what is done in the southern States of America. On the plantations Mr. Bovell and I visited there was not a very large area cultivated by any one planter. On only one of the plantations that we visited did we see as much as 100 acres under cotton at one time. That was due in the first place to the difficulty experienced in getting labour. In order to get labour, proprietors have to give a certain area, free of rent, for so may days' work on their plantations. Usually the labourer obtains about five acres of land for two days' labour a week. If additional labour is required it has to be paid for at the rate of fifty cents a day, and a certain number of persons are employed at a wage of $10 per month and have rations found them. The conditions are rather difficult for the planters owing to the indifferent character of the labour; it is expensive labour, and even at that is not quite satisfactory. It may be said that the planters of the Sea Island cotton districts have many difficulties to contend with that we have not in the West Indies. As regards the characteristics of the plantations, we visited several on James Island and found cultivation carried out in a

careful and systematic manner. I am referring now to the plantations owned by white planters who look after them personally and live on them The cotton seed is sown in April, the plant begins to flower in August, and picking takes place during the months of September, October and November. We were there in the middle of the crop time, and saw the people gathering the cotton, saw them bringing it in, spreading it out to dry, and saw it put through the gins We examined the gins very carefully and satisfied ourselves as to some of the difficulties to be met with.

Position of West Indies and Southern States.

Taking all the circumstances connected with cotton cultivation in the two places, I am of opinion the West Indies are better placed than the southern States of America. We have our own difficulties, I admit, and the severe lesson we have had this year with regard to the caterpillar is sufficient to discourage the weak-hearted, but it should not be sufficient to discourage those who are possessed of courage and are prepared to put their intelligence, energy and all available appliances to work in keeping the plant as free from disease as possible. We were told on every plantation we visited in the southern States that so far as the caterpillar worm is concerned there is no need for anxiety about it. If taken in time it can be easily dealt with.

Quality of Our Cotton.

With regard to the cotton grown here, it has been shown from the samples recently sent to England that it is quite as good as the average cotton grown in the southern States of America. As you are aware, the price of Sea Island cotton is much higher now than it was sometime ago; and we have been assured by the British Cotton Growers' Association that if we can establish the cotton industry and turn out cotton as good as the samples recently sent to England there is no reason why we should not make a fair profit. I shall not discuss the question of cultivation to-day. I hold in my hand a copy of the *West Indian Bulletin** which has just been posted to its readers, and will be in their hands this evening This number is devoted entirely to the cotton industry and contains all information available up to September last. In it are fully discussed the origin and distribution of Sea Island cotton and its cultivation. Then there is an article by Professor d'Albuquerque on the chemistry of cotton. There is also a paper by Mr. Lewton-Brain on Fungoid diseases of cotton, and another by Mr. Ballou, with illustrations on insects attacking cotton in the West Indies So that you have in the 90 pages of which the journal is comprised, all the information about cotton up to September last. We promise you in addition that the results of our visit to the United States will be published in a special number of the *Bulletin* which will be out during the next two or three weeks. Therefore, I can say that you are in possession of the fullest information it is possible for us to give you on the subject.

Picking Cotton.

Cotton should not be picked until the bolls are fully open and the boll-lobes slightly fluffy. In South Carolina cotton is usually picked

* This can be purchased at the Educational Supply Co., Kingston, Jamaica. Price Sixpence.

by women and children, who carry bags, two feet long by eighteen inches wide suspended round their necks, to put the cotton in. As soon as the bags are full they are emptied on osnaburgh sheets, two yards square. When there is sufficient cotton on these sheets they are folded across and the opposite corners tied together. The cotton is then weighed and loaded on carts to be taken to the factory Picking cotton is paid for by weight. The operation requires a little practice, but the picker soon learns the knock of extracting the contents of the bolls. An adult picker, who is expert at the work, picks from 100 to 150 pounds of seed cotton per day. Children of 12 years old pick from 20 to 30 pounds per day.

Drying Cotton and Preparing it for the Gins.

After the cotton is taken to the store-room, it is examined by the pickers who take out all bits of boles, pieces of leaves, etc The cotton is then spread on platforms or arbours to dry. After it is sufficiently dried, it it assorted and whipped Assorting cotton is taking out with great care all immature and stained bolls, bits of leaf and motes. Whipping cotton is striking handfuls of the seed cotton with a whipping motion on a mesh galvanised iron wire netting strained over a frame, 3 ft. long, 2 ft. wide and 6 in. deep. During this operation, the boll-lobes are more fully opened and any extraneous matter such as particles of soil, sand, etc., pass through the meshes. Whippers should prepare 300 lb. of cotton per day.

When the cotton is not properly prepared before it is sent to the ginneries a charge of three dollars per 1200 lbs. of seed cotton is made for picking, assorting and whipping it. After the cotton has been dried and prepared, it is allowed to remain sometime before it is ginned in order that the lint may absorb a little of the oil from the seed. It is thought that this adds to the silky lustre of the fibre.

In James Island where there are comparatively small factories (but all driven by steam) as soon as the cotton is made ready to be ginned by assorting and whipping as described, it is tied up in osnabugh sheets 3 yards square and sent to the ginnery. On the mainland, where there are large ginneries operating about 30 gins, the cotton is usually conveyed from the plantations to the factories in closed railway trucks. From these the cotton is drawn up to the top storey of the factory through large tubes from which the air is exhausted by means of a revolving fan.

Ginning.

On the arrival of the cotton at the factory it is weighed and hoisted to the top storey of the building known as the cotton loft. The cotton is then fed into shoots which pass through the floor just over each gin. While the cotton is being put into the shoots, the women or boys, in charge remove any bits of leaves which may have escaped the pickers and assorters. The object of feeding the cotton to the gins through these shoots is that in case of fire it is not readily ignited. From the shoots the cotton is fed to the gins as required Behind each gin there is an endless band or conveyer about 5 ft. long on which the lint falls as it comes from the gin. On each side of this conveyer, a woman stands to pick out any motes which may still have passed through the gin with the lint. Any bits of leaves or stained cotton which may

have escaped the pickers, assorters and shoot-fillers are also picked out at the same time. These conveyers, it may be mentioned, are driven by belting from the main shaft.

The lint which should now be quite white and free from impurities is taken to the baling room. Care is taken to remove the lint from the neighbourhood of the gins as fast as possible in order that in case of fire there is very little of it to burn.

Gins.

The best gins for long staple cotton almost universally used in the Sea Islands are McCarthy Single Action Single Roller gins made by Messrs. Platt Brothers, Messrs Dobson & Barlow, and Messrs. Lee of Oldham, Lancashire. These gins are, however, modified after being received to suit local requirements. A specimen gin so modified is now at the Central Cotton Factory at Bridgetown. The gins should be firmly placed on a solid masonry foundation and be quite level. In the Sea Islands they are usually placed on thick brick walls.

In setting a gin ready for working the following points should be carefully attended to. First, the leather-covered roller should be exactly parallel to the frame carrying the "doctor" knife. Then the bevelled edge of the doctor knife should be placed against the roller and in such a position that the edge of the bevel presses a little more on the roller than the heel. The edge of the doctor knife ought to be opposite the centre of the roller or slightly above it.

The beater should then be set so as to pass the edge of the doctor knife $\frac{13}{16}$ in. on its upward stroke and the same distance on its downward stroke. In other words, the length of the stroke of the beater ought to be $1\frac{5}{8}$ in. This will allow sufficient space for the cotton to come in contact with the roller. In many instances the beater shaft is raised higher than when sent out from England so that the arc formed by the beater is equi-distant from the roller when at its highest and lowest points and nearest to the doctor knife when passing its edge.

The spiral grooves of the roller should not be more than one-sixteenth of an inch deep and should all be on the edge of the flesh side of the walrus hide. Care should be taken to see that the roller has been turned true and that it is always the same distance away from the doctor knife along the whole of its length. The leather on the roller usually remains in good condition for sufficient time to clean about 100 to 125 bales of lint. After that period it will probably require to be renewed. An extra roller should always be ordered with each gin so that the work of ginning may not be interrupted. The rollers are covered with a specially prepared walrus hide. This is said to cost in London about 3/ per pound. It requires 18 pounds to cover a single roller. During the present season it will probably be found more convenient to order extra rollers from the makers than attempt to cover them in the West Indies. On many of the gins in use in the Sea Islands a brush is adjusted in place of the wooden or iron bar which hangs against the back of the roller to prevent the lint from being carried round with the roller and so causing what is known as "back lashing." The latter if not immediately attended to may cause the doctor knife to be forced outward until it comes in collision with the beater. The brush is attached to the frame of the conveyor be-

hind the gin and fixed in position with a thumb screw and slotted angle iron so that it can be properly adjusted. Before the gins are used "links" (or connecting rods attached to the beaters) of a different construction are often substituted for those sent with them.

In almost every instance, the gins are driven by two belts, one driving the roller, from about 140 to 175 revolutions per minute, and the other the beater at the rate of from 850 to 900 revolutions per minute. *The longer the staple the slower the roller ought to turn so as not to break the fibre.*

Fires.

Owing to cotton being very inflammable, fires sometimes occur in the factories and many precautions are taken to prevent it spreading. Some of the buildings are lined with tin or galvanized iron; others have the insides of the factories painted with fire-proof paint. In some instances it was observed that a pipe from the boiler entered the ginning room and in case of fire all windows and doors were immediately closed and the room filled with steam. In most factories buckets of water, containing an osnaburg sheet soaked in them, were suspended by each gin, so that, in the event of the lint taking fire, the wet sheet could at once be thrown over the flames. At all the best factories, water under pressure is laid on with a hose always ready for use.

Baling.

From the ginning room, the lint is taken to the baling press which is sometimes in a separate room. For Sea Island cotton the press is entirely different from that used for Upland cotton. In the Sea Islands it is usually worked by hand. In one large ginnery in Georgia it was observed to be worked by steam. The construction of the hand power press in which the lint is pressed into a large sack by a plunger is is as follows: The upper portion of the press which contains the rack and pinions for raising and depressing the plunger rests on the floor. Just beneath the plunger, a hole is cut in the floor, slightly smaller than the size of the bale In this hole the top end of the bale-bag is passed and tacked around an iron ring, slightly larger than the hole, which thus keeps the top of the bag suspended. Underneath the bale-bag on which it just rests there is a platform suspended by four iron rods from the base of the press. This platform can be lowered or raised by means of nuts with handles working on threads run for some distance on the rods. The bale-bags which are 7½ ft. long are made of Dundee sacking. Two qualities of this sacking are used, one which weighs 2 lb. per yard and the other, which is thicker, 2½ lb per yard

As soon as the bale-bag is filled to about one-third of its length, the plunger is lowered into the bag and the lint pressed. The plunger is then allowed to remain in the bag on the lint until the next lot is ready when it is withdrawn and the lint inserted. This operation is continued until the bag is full, when it weighs about 400 lb. Before the bag is put into position to receive the lint a handful of cotton is put into each corner at the bottom and an "ear" made so that in lifting the bale the workmen have something to hold by "Ears" are also made at the corners of the bag when the bale is being sewed up.

A Sea Island bale of cotton when ready for shipment, is a long cylindrical body with four ears (two at each end) resembling a " pocket" of hops. There are no bands of hoops. The stitching along the side and ends of the bag should be strong enough to bear all the pressure considered desirable to apply to the best sorts of Sea Island cotton.

To Estimate the Yield of Cotton Lint per Acre.

In the Sea Islands, the yield of lint is estimated from the number of bolls on the plants. The bolls on a number of plants of average size are reckoned and the average obtained. For every fifteen bolls, where the plants are in rows 5 ft. apart and 20 in. apart in the rows, the yield is usually about 100 lb. of lint per acre. Of course this varies slightly with the variety of cotton and with the yield of lint per 100 lb. of seed cotton. On the average 300 lb of lint is obtained from 1100 lb. of seed cotton. Sometimes, however, where the variety has large seeds and where the seed cotton has been kept for an unusually long time, as much as 1,500 is required to yield 300 lb. of lint.

Cost of Ginning.

The cost of ginning cotton in the Sea Islands, is usually from 3 to 4 cents per pound of lint, the ginner supplying all baling material free of cost. As already mentioned, if the seed cotton is not already picked over, whipped and assorted before it is sent to be ginned, an extra charge at the rate of $3·00 for every 1,200 pounds of seed cotton is made by the ginner. This is a matter that deserves to be carefully borne in mind by cotton growers in the West Indies. If the seed cotton is not properly prepared beforehand, it will be impossible for the ginning factory to clean and bale it satisfactorily at a cost of 3 to 4 cents per pound of lint.

Diseases of Cotton.

In the United States there are several very destructive diseases affecting cotton. Among the most dreaded of these is the Mexican boll worm. This has not reached the eastern portions of the cotton belt. It has been reported from Cuba, and on that account it is undesirable that any cotton seed or, indeed, any portion of the cotton plant should be introduced from that island into the West Indies. A disease known as 'wilt' or " Frenching" affects Sea Island cotton in Carolina, Georgia and Florida. It is being kept in check by raising varieties resistant to this disease Neither the Mexican boll worm nor the wilt have so far been observed in the West Indies I was careful from the first to point out that we could not hope to grow cotton here without having to deal with disease of some kind. In February last it was stated in the *Agricultural News* (Vol. II, p. 50) : " Pests will appear wherever cotton is grown, and they should be looked for and at once dealt with. If pests are expected as part of the regular routine of cultivation they are less likely to be feared." Again in the *Agricultural News* (Vol. II, p. 242) there appeared the following: " Finally, we would repeat what we have already impressed upon the planters, viz: that they should keep a watchful eye for insect and fungoid pests and *immediately* communicate specimens and seek the advice and assistance of the officers of the Imperial Department of Agriculture."

Among the pests that have troubled cotton at Barbados this year the most widely-spread and destructive has been the caterpillar or

worm of a moth (specimens of which are on exhibition in the Hall) known as *Aletia*. The attack of this was so sudden and severe that the damage was done before the planters had realized what was going on. There was also the drawback that there was only a small supply of Paris Green in the Island. The life-history of the insect is well known, and it is fully given in the current number of the *West India Bulletin* (pp. 268–271). I am of opinion that if a keen look out be kept for this cotton worm in September and October of each year and immediate steps be taken to deal with it as advised by the officers of the Department there is every probability that it can be effectually kept in check.

In the United States where it is equally abundant, if not promptly dealt with, the planters do not regard is as troublesome. They treat it when the worm is only about $\frac{1}{8}$ or $\frac{1}{4}$ of an inch in length; and one or two dustings with Paris Green and lime in the proportion of 1 to 6 are sufficient to get rid of it.

We must recognize that at Barbados with practically the whole of the available land under constant cultivation and with a dense population the conditions, from the agricultural point of view, are becoming more and more artificial. The fight with pests must be accepted as inevitable; and it is only by intelligent and energetic action on the part of all members of the planting community that we can hope to raise large and remunerative crops. We might assist in placing matters in a more natural condition by planting trees on all waste areas, and by encouraging birds, lizards and all insectivorous members of our fauna. If we had large areas under trees, our climate would be moister and less liable to suffer from severe spells of dry weather; and if we had double or treble the quantity of insectivorous birds we have at present, our conditions as regards some pests at all events, would be greatly improved.

Besides the cotton worm there are several fungoid diseases causing blight on leaves and pods. It has been noticed that these are more prevalent on ratoons than on plants At present it is unadvisable to attempt to raise any ratoon crops of cotton After this year's crop is reaped, it would be better to get rid of everything and make an entirely fresh start next year. After a careful review of all the circumstances and after visiting most of the areas planted with cotton this year I am convinced that, with thoroughly intelligent and active treatment of the cotton worm and other pests, no insuperable difficulty has yet presented itself in the way of establishing a successful cotton industry in this island.

Cotton seed for planting in 1904.

There are several sorts of cotton being grown experimentally this year. Owing to the risk of crossing, it is recommended that an entirely fresh supply of the best seed be secured for planting next year. They begin planting cotton in the States in April. The planting season in the West Indies is from June to August. If, therefore, immediate steps are not taken to secure seed of the best Sea Island cotton in advance of the States, the West Indies will have to put up with inferior sorts. With the view of securing, beforehand, a large supply of seed of the best Sea Island cotton for these colonies, during my recent visit I obtained the refusal of all the seed produced on one of the

most successful plantations on the sea-board of South Carolina. On this plantation the proprietor has for several years carried on experiments with the United States Department of Agriculture in raising disease-resistant varieties as described in the *West Indian Bulletin* (Volume IV., pp. 201-214). The lint is of fine quality and has uniformly obtained the highest prices. The seed will be carefully cleaned and sorted, and will be delivered with a guarantee that it is the product of this plantation and no other. It is estimated, as already announced on p. 379 of the *Agricultural News* 'that this seed will cost delivered to the planters in the West Indies, about 7 cents per lb. (or at the rate of 1/9 per acre), and as it will have to be paid for when ordered, those requiring it should note that it must be paid for in advance.' The date for closing orders for this seed has now been extended until January 4th 1904 After that date the Department will be unable to procure any further supplies of this selected Sea Island cotton seed. It will, however, continue to assist in obtaining other seed ; but the latter may not be of so good a quality and it may cost more. The importance of selecting good cotton seed is very emphatically dealt with by Mr. Herbert J. Webber, Physiologist-in-charge of the plant-breeding laboratory connected with the United States Department of Agriculture :—" As well might the breeder of fast trotting horses introduce dray animals into his stables, or the breeder of intelligent hunting dogs introduce ordinary mongrel curs into his kennels. The use of good seed and its production by a regular system of selection is just as important a factor in the production of the crops as that of cultivation.

No intelligent method of farm management disregards the production and use of good seed The day when growers can afford to plant any sort of cotton seed has passed. Only seed of a known variety selected because of its desirable qualities and adaptability to local conditions should be planted."

In answer to questions put to him Sir Daniel Morris said he would not advise any one to ratoon cotton this year owing to the presence of of disease. Where the worms destroyed the middle part of the plant, and it was the wish of the grower to obtain a crop, he should cut off the top below the diseased portions in order that the shoots might come up. The present crop would not have been so advanced had it not been for the dry weather which prevailed in November. What they wanted was for the crop to be in such a state that it could be reaped during January, February and March. He did not think Peruvian cotton was likely to suit us, because it was a perennial plant. What was required in this island was a short season cotton, one of five or six feet in height with large branches. With regard to wild cotton, he did not think it was likely to be dangerous to Sea Island cotton unless it were allowed to grow to windward of such cotton, when its pollen would be easily carried into the field. He thought growers were delaying too long the picking of cotton that was fit to be picked. The best thing would be to pick it every two or three days—at least twice a week. The capsules of the Sea Island cotton did not open so much as the Peruvian cotton, and that was one difficulty in picking it. Directly the capsules were open to such an extent that one's fingers could get inside, the cotton should be removed He believed that one

danger of leaving the cotton too long before it was picked was that it might attract the attention of some animal which might develop an appetite for it.

Cultivation in Jamaica in 1842.

Examination taken before the Committee to whom was referred the Petition of Henry Gourgues.

Wednesday, 14*th December*, 1842.

Examination of Henry Gourgues.

Question. Have you at any time raised cotton in this island? If so, state where, when and to what extent?

Answer. I have raised cotton in Liguanea, in St. Andrew, in the year 1841, to the extent of ten thousand pounds weight

Q. At what cost have you raised cotton, per acre, and what amount has an acre of land, cultivated in cotton, yielded?

A. The cost of cultivation will be shown by the following statement of expenses incurred in establishing ten and three-quarter acres of land in cotton, and the returns therefrom in one year.

		£	s.	d.
Labourers, cleaning, digging stumps, &c. ...		9	3	10
Digging holes and planting ...		11	6	6
Weeding four times during the year, job-work, at 12s, per acre each time ...		25	16	0
Picking off the trees thirty thousand weight of seed cotton, at 1s. for every 40lbs (task work) ...		37	10	0
Four labourers ginning 110lbs. of clean cotton daily, at 1s. 6d. each per day, equal to 6s. for every such 110lbs ...		27	5	10
One doz. oznaburgh bags for picking cotton in the field		0	14	0
Two hundred and twenty-one yards of bagging, 38 inches wide, at 7½d. per yard, each bale of 300lbs. taking six and a half yards, £6 18s. 1d., twine 16s. ...		7	14	1
		£119	10	3
Cr.				
By eight thousand weight of clean cotton at 6d. per lb. net	£200 0 0			
Two thousand ditto, stained ditto at 4d.	33 6 8			
		233	6	8
Gain		£113	16	5

Equal to £11 per acre

Next crop I must expect double the quantity of cotton, the trees being older, and bearing more fruit: it is well known that the perennial cotton tree seldom produces a full crop before the second year of its

*Reprinted from the "Votes of the House of Assembly."

growth, but estimating the crop at only eighteen thousand weight, the result will be as under:

	£	s.	d
Cleaning field twice a year	12	18	0
Pruning once, £6 12s.; picking at 1s., for every 40 lbs. £67 10s.	74	2	0
Ginning, 6s. for every 110 lbs.	49	2	6
Bagging, £12 3s 9d.; twine. 25s.	13	8	9
	149	11	3
Estimated crop of eighteen thousand weight at 6d. net	450	0	0
Gain	£300	8	9

Equal to £30 per acre.

Q. State the mode of cultivation adopted by you in detail?

A. I beg to lay before the Committee the following statement, which will afford the information required I planted my cotton the end of April, 1841, and the crop commenced in September, and finished in December; consequently about five months after planting, I commenced picking. The blossoms appeared the end of July, and beginning of August, the pods opened six weeks after the blossom appeared, all the pods are not developed at the same time, but gradually so that a field has to be gone over several times before the whole crop is taken off. The crop which is picked between September and December, runs great risk of being damaged or stained by the October rains. The parcel mentioned in my statement as stained was damaged during that time, and as I could get no labourers to work continuously then I lost a good deal of cotton, which was washed away by the heavy rains. The same risk does not attend the second crop, as it is picked between February and April, before the May seasons set in. I employed women to collect the cotton, as they were more expert at it than the men; they would frequently pick more than their task, but the men not one half; the task is 40lbs a day of seed cotton, for one shilling, but in a large field, I am certain they could pick double that quantity with ease. It is seldom that the perennial cotton tree produces a full crop before the second year of its growth, as I am informed, consequently, I have every reason to expect a much larger quantity of cotton from my field next year, from the favourable appearance of the trees. which are now covered with pods. I consider this information correct.

Q. How many years do the cotton trees continue to grow, and produce cotton, so as to render the cultivation profitable?

A. The perennial cotton lasts five years, and the other description of cotton lasts but for one year.

Q. Have you commenced picking your present crop, and what was the description of seed which you used?

A. I shall not be ready for picking until February next. The seed that is used is the seed of the Sea Island cotton.

Q. Are you extending your field?

A. Not yet, but I am anxious to extend it, under the conviction that it will be profitable.

Q. Does your present field look promising?

A. Beautiful. The land is composed of hard dry clay, and sandy soil.

Q Are you aware of any person competing with you in the rearing of cotton.

A. No one, to my knowledge.

Instructions for Planting Cotton.

By T. J. Harris.

Cotton should not be planted in districts where the wet and dry seasons are not well defined, as uncertain weather is ruinous to the crop.

Soil.—A light sandy loam is the most suitable soil, though the plants grow luxuriantly in rich heavy soil if allowed sufficient room to develop, yielding, however, a smaller crop of cotton per acre.

Preparation of land—The land should be thoroughly forked or close ploughed east and west, and the clods well broken afterwards Furrows about six inches deep, and four feet apart, should be made if the soil is light and rather poor, and five to five and a half feet if the land rich; this time working north and south.

Sowing.—The seeds should be sown in July, as soon as possible after the furrows are made, the number of sowers being sufficient to keep up with the ploughman who is making the furrows. Each sower should be provided with a measuring stick; the stick to be 15 in. long for the 4 ft. apart rows, and 2 ft for the wider planting in rich soil. At the spot where the plant is to grow, the soil is drawn away with the fingers to the depth of 1½ inches and four inches wide; five to eight seeds are sown and lightly covered, pressing the soil down somewhat firmly with the fingers if it happens to be rather dry.

Supplies—As a rule the seeds germinate in four or five days, and at the end of two weeks a few of the rows should be examined as to whether supplies are needed; if any of the holes have failed, the whole field should be gone through and supplies sown at once.

Cultivation.—In a few weeks, depending on the weather, weeds will begin to show signs of starting into growth; a hoe or cultivator should now be used, repeating as often as necessary throughout the growing period to keep down weeds and to conserve soil moisture. It is well, however, to avoid having a dusty surface when the bolls burst, so cultivation may cease soon after the first bolls have formed.

Thinning—When the seedlings have developed their second true leaf they should be thinned out to one in a hole, leaving only the strongest plant; in light friable soil the discarded ones may be pulled out, but if the soil is sticky and there is danger of disturbing the roots of the one that is to remain, they should be cut off below the two round seed-leaves.

Moulding.—Half the soil on each side of the furrow should be drawn up to the plants with a hoe when they have attained the height of nine inches, and the remaining half when the plants are 18 inches to 2 ft high; in windy situations neglect to mould is fatal, as the plants are very brittle at the collar and liable to snap.

JAMAICA CASSAVA. II.

BY

H. H. Cousins, M.A. (Oxon), F.C.S.

Government Analytical and Agricultural Chemist.

In continuation of the study of local varieties of Cassava* the following results have since been obtained and are here placed on record.

Manchester Cassavas.

Four varieties of local reputation were submitted by J. T. Pa'ache, Esq., who grew them at his Experimental Garden at Clover near Mandeville. Three are bitter and one a sweet variety. The latter gave the highest yield of Starch. It is noteworthy that the cassavas grown in the Manchester hills do not contain so much starch as the varieties from Inverness and Hope Gardens grown at a lower elevation.

These varieties support Carmody's rule as to the distribution of the Hydrocyanic Acid between the cortex and the interior of the tubers being distinctive of sweet and bitter cassavas

The proportion is as follows:—

	Variety.			Per cent. of Total Hydrocyanic Acid in cortex.
1.	"New Green"—Bitter		...	18 2
2.	"Mass Jack"	,,	...	14·6
3.	"Blue Top"	,,	...	27·8
4.	"Fustic"	Sweet	...	50 0

Cassavas from Prison Farm, Spanish Town.

A representative collection of creole varieties of cassava was being grown by Mr. J. T. Palache at the Prison Farm for records of tonnage and starch yields.

The hurricane on August 11th, 1903, destroyed the plants and prevented the completion of the rial. It was thought desirable, however, to analyse the tubers produced, although they were not ripe, as a guide to the comparative maturation of the varieties. Luana bitter and White Stick sweet came out well in this series. From the commercial point of view the gross indicated yield of starch per acre must be seriously qualified by the length of time that a variety requires to attain such results.

The results of "Fustic" as against "Brown Stick" in this exper men may have an important bearing on the comparative commercial value of the two varieties.

We recommend "Fustic" Cassava to the attention of cassava growers as a variety capable of very early maturity.

* Bulletin Vol. I. June and July, page 130.

Cassava from Mandeville. J. T. Palache, Esqr.

No	Name.	Description of Tubers	Hydrocyanic Acid.			Moisture.	Total Solids.	Glucose.	Sucrose.	Starch.	Glucose Value.
			Cortex.	Interior.	Total.						
1.	New Green Bitter .	Brown, irregular, medium size .	0·014	0·063	0·077	61 91	38·09	0 07	1·24	27·83	29·10
2.	Mass Jack Bitter .	Brown, long, slender .	0·007	0·041	0 048	57 64	42·36	0 09	1·00	27 71	28·75
3.	Blue Top Bitter .	Light colour, slender .	0·010	0 026	0·036	66·84	33·16	0·08	0·76	27·94	28·75
4.	Fustic, Sweet .	Light colour, long & stout	0·005	0·005	0·010	58·90	42·10	0 06	1·06	29·59	30·67

Cassava from Prison Farm.

No.	Name.	Description of Tubers.	Total Hydro-cyanic Acid	Moisture.	Total Solids.	Glucose.	Sucrose	Starch.	Glucose Value.
1	Black Stick ...	Brown, rough, long ...	0·045	68·84	31·16	0·06	0·11	19·01	19·17
2	Brown Stick ...	Brown, rough, long ...	0·046	71·84	28·16	0·06	0·11	15·17	15·33
3	Black Bunch of Keys	Dark, rough, medium ..	0·045	67·66	32·34	0·08	0·03	19·07	19·17
4	Blue Top ...	Brown, rough, slender	0·042	71·66	28·34	0·12	0·01	19·05	19·17
5	White Stick Bitter ...	Light, smooth, long .	0·030	73·24	26·76	0·08	0·12	15·67	15·86
6	New Green ...	Brown, rough, medium	0·026	83·37	16·63	0·14	0·06	9·2	9·39
7	White Stick Sweet ...	White, long, stout ..	0·024	61·31	38·69	0·03	0·11	26·93	27·06
8	Fustic Sweet ...	Light, long, stout ..	0·013	86·03	13·97	0·04	0·10	4·47	4·60
9	Luana ...	Brown, rough, medium	0·026	58·74	41·26	0·04	0·21	28·88	29·11
10	Yellow Belly ...	Brown, rough, small ...	0·005	75·46	24·54	0·03	0·47	13·91	14·37

Cassavas from Longville.

The first factory for making Cassava Starch in Jamaica upon a commercial scale has been erected at Longville, through the enterprise of Mr. J. W. Middleton

We consider this to be the most important undertaking for establishing a new industry in Jamaica which has been set on foot within recent years, and the results obtained by Mr. Middleton will undoubtedly play a great part in deciding as to the present prospects of Cassava in this Island as a staple export.

The demand for Cassava Starch of high quality for dressing Manchester goods has recently been impressed upon us by the visit of a prominent representative of the industry in Manchester If Jamaica can produce a high quality Cassava Starch, free from fibre, grit and dirt and also free from the organic acids of fermentation which so readily arise when Cassava tubers are allowed to stand or the manufacture carried out in a dilatory and imperfect manner, there is an assured market for all we can produce and at a remunerative price.

Analyses of four consignments of Cassava from Longville of two varieties "white" and "brown" may here be given. These represent Cassava in an immature state, still growing and likely to give a considerable increase both in tonnage and in starch-content when more developed.

Further investigation of these Cassavas is in progress.

Analyses of five varieties grown at Longville and identified by Mr. W. J. Thompson as Luana, Burrill, Brown Stick, Prize Stick and Bluebird are also recorded.

Cassava received from Longville 28/8/03 & 2/9/03.

No.	Name.	Description.	Hydrocynic acid per cent.	Moisture per cent.	Total Solids per cent.	Glucose per cent.	Sucrose per cent.	Starch per cent.	Glucose Value.
1	...	Brown 29·8 .	—	65·57	34·43	0·07	0·25	26 76	29 41
2	...	White 29·8 .	—	61·69	38·31	0·20	0·89	28·45	32·05
3	...	Brown 2·9 .	0·012	65·37	34 63	0·33	0.92	24·35	27 77
4	...	White 2·9 .	0 031	61·46	38·54	0·66	0·59	27·55	31·25

Cassava Varieties from Longville

No.	Name.	Hydr. cyanic Acid.			Peeled Tubers.				
		Total Per Cent.	Per Cent in Cortex	Per Cent in inside.	Moisture %	Total Solids %	Sugars %	Starch %	Glucose Value.
1	Luana .	0·037	34·0	66·0	58·4	41·6	0·3	24·4	26·9
2	Burrill .	0·027	39·7	60·3	56·7	43·3	0·6	24·9	27·8
3	Brown Stick .	0·011	38·5	61·5	60·0	40·0	0·7	28·5	31·6
4	Prize Stick .	0·042	26·1	73·9	65·1	34·9	0·2	29·1	31·8
5	Bluebird .	0·010	32·4	67·6	56·0	44·0	0·3	31·2	34·2

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board was held at Headquarter House on Tuesday, 12th January, at 11.15 a.m. The Members present were: The Director of Public Gardens and Plantations, the Agricultural and Analytical Chemist, the Archbishop of the West Indies, the Hon. J. V. Calder, and Messrs. C. E. de Mercado, C. A. T. Fursdon, and J. Barclay. Secretary.

His Grace the Archbishop was elected to take the Chair.

It was decided to advertise for tenders for properties which might be suitable for the proposed dairying farm and agricultural school.

As nothing had been done in the matter of the improvement of the cattle dock at the railway station, the Secretary was directed to forward the representations on the subject made at the previous meeting of the Board to the Government.

With reference to the remarks made by the Archbishop at the previous meeting on the subject of the carriage of pine-apples, etc., the Director of Public Gardens submitted an extract from the *Times* of Ceylon giving particulars of the canning industry.

The matter of the sugar experimental station was again discussed, and a proposal by the Chemist for the extension of the Laboratory so as to enable the addition to be devoted to work on sugar and rum experiments by himself and the Fermentation Chemist. The Board decided to construct the new Laboratory and to carry out the scheme proposed by the Chemist, provisionally for one year.

The Secretary submitted the names of 17 applicants for the £5 grants for experiments in cotton cultivation.

The Chemist submitted reports (1) on the term's work of students at the Laboratory; and (2) on cassava starch and glucose experiments.

The Director of Public Gardens submitted a report on ths Hope Experimental Station, which was directed to be published and circulated.

GRASS OILS, III.

As the formulæ on pages 276, 278 of the December Bulletin are out of line, and are not intelligible, the following should be substituted:—

Page 276, we found for this Oil :

Sp. gr. at 15°	0·8947
Rotation, 100 mm.	—4° 16′
Refractive index at 20°	1·47098

It also showed a low acid number, and contained 86·4 per cent. total $C_{10}H_{18}O$, with a citronella content of 25·43 per cent.

Page 278, we found

Sp. gr. at 15°	0·8922
Rotation, 100 mm.	–·0° 9′
Refractive Index at 20°	1·48825

TINNED PINE-APPLES IN JOHORE.

The "Overland Times of Ceylon" gives some particulars about the cost of tinning pine-apples in Johore afforded by Mr. Landau, partner in the French firm of Landau & Co. Mr. Landau was engaged in the business in Johore for nine years. He has come to the conclusion that a lucrative business can also be carried on in Ceylon, and hopes shortly to launch out on this new venture. He gave our representative many interesting facts about the industry. The Ceylon pineapple, he says, is excellently adapted for preservation, just as is the Mauritius variety; and it is one of the best on the market. To start the business a very large capital would not be required. It would be necessary, first of all to secure the services of a man who knows the island thoroughly, and who can get in touch with pineapple growers, so as to ensure a cheap and plentiful supply for treatment. The machinery would not be expensive. It should probably be all obtained for less than R1,000. It would also be necessary to employ the services of a Chinese carpenter to make the cases, which should be able to hold two dozen tins of preserved pineapples. The Sinhalese carpenter, says Mr. Landau, is far too expensive, and moreover, while he makes only 10 cases a day, the Chinaman has not done a good day's work unless he has made 50 cases. The Chinese carpenter is paid 12 dollars a month, or R15; the Sinhalese carpenter wants 75 cents a day.

Pineapples can be preserved either in their own juice or in syrup. The fruit is first of all placed in tins, which are sealed and then boiled. By a patent process, Mr. Landau says, he is able to extract the heat and steam from the tin. Otherwise the tin would burst. It is also essential that the outside of the tins should be cooled, or else they become rusty, and consequently the fruit is made unfit for consumption.

Mr. Landau suggested a method which is in vogue in Java for securing the services of natives who grow pineapples. A small sum of money, say 200 dollars, is advanced to those who possess, perhaps 50 acres of land; and a contract is made with them to deliver pineapples for so many years at a certain fixed price, and, no matter what the fluctuations, this price is maintained. It was important, he said, to remember, that the pineapple plant bore fruit in 18 months, after which time it required little attention.

He feels confident that a lucrative business can be established here, and quoted some statistics in support of this contention. A pineapple tin would cost him about six cents. His brother at Johore is able to turn out about 220 dozen tins of preserved pineapples a day in the height of the season, or about 1,200 tins a day throughout the year. His net profit is one dollar 20 cents. on each dozen cases. Mr. Landau has calculated that he could clear a profit of R1·83 on each dozen tins of pineapple which he made in Colombo, and he expected to make at least 50 dozen tins a day, which would bring him a profit of say R90 a day, or £1, 800 a year.

Mr. Landau has tried his hand at preserving papaw, which, he characterises as one of the most valuable fruits in existence. The other day he made some papaw jelly. Out of a papaw 3 lbs. in weight with a proportionate amount of sugar, he says three lbs. of papaw jelly can be made. He also thinks of preserving the unripe papaw in tins, and the jâk fruit.

GRASS AND FRUIT TREES.

The third report on the Woburn Experimental Fruit Farm, recently issued by the Duke of Bedford and Mr Spencer Pickering, F.R.S., is devoted to a discussion of the effects of grass on apple trees. In previous reports it was shown that grasses prove most injurious to young apple trees, and the experiments described here were designed to throw light on the causes of injury. Up to the present time the cause, or causes, have not been discovered, but the experiments have made considerable progress, for they have shown that their first suspicious were unfounded. Grasses might reasonably be expected to injure young fruit trees by interfering with their air, or water, or food supply, but the careful experiments recorded in the report indicate that interference with air, water, and food has little or noting to do with the question, and that the injury 'must in all probability, be attributed to the action of some product, direct or indirect, of grass growth which exercises an actively poisonous effect on the roots of the tree." This conclusion is based partly on the negative evidence of the experiments, in which the supplies of food, air, and water were controlled, and partly on the appearance of the trees grown in grass. These trees were always very sharply marked off from the others by peculiar tints of leaf and fruit, quite unlike those due to starvation, and produced obviovsly by some unhealthy condition of soil. The effects of grass on apple trees have been studied only on the shallow clay soil of the Woburn Fruit Farm and on a clay soil at Harpenden, and it is possibie, as the experimenters are careful to point out, that on a richer soil, and in a different climate, grass might not prove injurious, but the Woburn experiments clearly indicate that horticulturists should avoid planting apples in grass, unless there is local evidence that grass does not injure the young tres.

In their work on apple trees the Duke of Bedford and Mr. Pickering are dealing with a special and well marked case of a general problem of great interest to agriculturists—the effects of crops and of crop residues on the quality of soil. Every observant cultivator knows that land may get "sick" or "over-cropped" when a plant is grown too often, and he also finds that certain plants "exhaust" the soil in a peculiar degree for certain other plants. He has been told that this is a "food" or a "special food" question, and that interference with the air, food, and water supply explains all the ills which plants may suffer from competition with their fellows. At the same time, he does not feel satisfied that such phenomena as the disappearance of clover from land, or the effects of rye-grass on wheat are due to straightforward competition, and the "poison" theory of the Woburn experimenters will arrest his attention. Seventy years ago agriculturists were discussing De Candolle's "excretory theory," and found in it the chief explanation of the benefits due to a rotation of crops; when the theory was abandoned, the facts from which it originated were forgotten, and in connection with the effects of grass roots on apple trees, the following sentenced from De Candolle is worth recalling:—Thus we know that the thistle is injurious to oats, the Euphorbia and Scabiosa to flax, the *Inula betulina* to the carrot, the *Erigeron acre* and tares to wheat, &c." Though the plant does not "excrete," it may readily influence

the character and condition of the soil either directly by the decomposition of its roots, or indirectly through its effect on soil organisms, and the Woburn experiments, which deal with this subject, will be closely followed. (*Nature.*)

REVIEWS AND NOTES.

On Cane Sugar and the process of its manufacture in Java.

By H. C. Prinsen Geerligs. Published by "*The Sugar Cane*," Altrincham, England. Price 5/.

The Director of the West Java Sugar Experiment Station, who has done more than any other living Chemist to extend our knowledge of the chemistry of the sugar cane and the technology of the manufacture of Cane Sugar, has here put together all that it is of importance for the scientific Director or Superintendent to know respecting the management of a Cane Sugar Factory. We confidently affirm that this is a most valuable and authoritative work and one that can not fail to be of great practical service to sugar producers in all cane growing countries.

The subject is naturally sub-divided into two portions, Part I. The Raw Material and Part II. Sugar Manufacture.

The composition of the cane is clearly set forth in a concise manner with the minimum of chemical technicalities for a sound presentation of the subject.

The Second Part of the Book, however, contains matter of most direct practical importance in Jamaica.

Mr. Prinsen Geerligs states as regards the contest between diffusion and milling that the decision becomes more and more decided in favour of the latter owing to the many improvements which have been made in mills and appliances for preparing cane for milling during the last few years.

Defecation, Carbonation and Double Carbonation, the use of Phosphoric Acid and of Sulphurous Acid are successively considered.

Our chief needs in Jamaica are clearly better milling and the general use of Triple Effets for evaporation. Mr. Geerlig's data on these points emphasise the great loss we incur in Jamaica in the initial recovery of juice from the cane and again the great advantage of the vacuum evaporation process over the open battery generally employed in this island.

Our Sugar Industry in Jamaica will stand or fall on the possibility of working estates producing 500 to 1,000 tons of sugar per crop under the new conditions.

It is clear, therefore, that in Jamaica we can not carry out the full elaboration of a modern sugar factory and there is much in Mr Geerligs' book that it would be impossible to carry out generally in this island. Efficient double crushing, and a triple effet should be on every estate where sugar is the main object of manufacture.

We cordially recommend every attorney and manager in Jamaica to purchase this book and to study it carefully.

SUGAR HOUSE NOTES AND TABLES. By Noel Deerr. Spon. London.

This compilation, arranged in alphabetical order, is a welcome addition to the literature of the Sugar Cane.

It contains in a condensed form data and information on all branches of Boiling House and Distillery Management. This work should be in the hands of all engaged in the direction of sugar manufacture in the tropics.

H. H. C.

EUCALYPTUS IN THE TREATMENT OF DIABETES.*

New remedies for diabetes are not uncommon, but none of them has so far stood the test of experience. Nevertheless a suggestion which we owe to the late Mr. James Dick, the Glasgow millionaire, and to Mr A. G. Faulds, of the Glasgow Royal Infirmary, is one which should be tried by those who have opportunities of treating diabetic patients. The origin of the suggestion, as told by Mr. Faulds, is that some years ago Mr. Dick was travelling in New Zealand, and knowing that an old schoolmate of his was in the country, he determined to hunt him up. After considerable journeying he found his old friend, and a most agreeable interview followed. During this meeting the settler complained that his health had failed some years after he had settled in New Zealand, and that the doctors had treated him for diabetes with but little effect. One day, however, having contracted a horrible cold or influenza, a neighbouring old native lady informed him that if he went to a certain eucalyptus tree and gathered some of the fresh leaves, and partook of an infusion of them twice or three times daily, it would cure his influenza. The patient acted upon this advice at the earliest opportunity. He made an infusion of the fresh leaves, and took a small teacupful night and morning, with the result that it not only cured his influenza, but caused his diabetes also to vanish with all its symptoms. Mr. Faulds has endeavoured to test this remedy in the following manner: He obtained some of the dried leaves of Eucalyptus Globulus, of which an infusion was made in a teapot by taking one tablespoonful of the broken leaves, about 60 gr. in weight, and adding 6 oz. of water, allowing it to infuse for half-an-hour, and then adding a little saccharin. This quantity was given twice daily, and the remedy has been tried upon 46 cases, in 15 of which Mr. Faulds reports total disappearance of the disease, and so far as can yet be judged, a complete cure. The substitution of eucalyptus oil and eucalyptol was followed by no effect at all upon the sugar, and Mr. Faulds is unable to indicate to what constituent in the chemical composition of the infusion the therapeutic effect is due. —(*British Medical Journal, May 24th, 1902.*)

What seems very interesting is the fact that when the patient gets a fresh warm infusion, the sugar at once drops in quantity, and in some cases from 60 grains to half a grain per ounce. It is evident, then,

* The virtues of Eucalyptus in treatment for diabetes has been known to the peasantry of Jamaica for at least five years. *Ed.*

that there is not any one of the substances contained in this infusion that arrests the excretion of sugar, but evidently a combination of them have this effect, i.e., there seems no alkaloid in it which, when given alone, has the power of influencing the amount of glucose in diabetic urine. Then how and why the fresh infusion act so promptly? The writer thinks that, just as a newly infused cup of tea is an enjoyable beverage, not on account of the action of its alkaloid theine alone, but because it contains, in addition, a mixture of a volatile oil and tannin, so does tea from eucalyptus (which we know has antiseptic properties) act in checking tissue metamorphosis, which is so active in this disease.

The causation of glycosuria is still wrapped in mystery, but it is probably produced by a variety of causes, such as gout, cold, nervous exhaustion, and over indulgence in food and drink In fact, any condition which tends to limit or prevent the appropriation of sugar in the blood, must lead to an excess of sugar in the blood, and thus to glycosuria. In these cases, it seems that in the earlier stage the eucalyptus treatment will prove beneficial; but where the disease has been inherited, or where the patient's antecedents or immediate relatives are neurotic (in which case the probable cause is a progressive degeneration of the vaso-motor centres of system which will disturb the equilibrium of the blood-supply to the hepatic cells), this treatment, like others, will be of no avail. And such has been the author's experience, for in 41 cases treated with eucalyptus, 11 came from talented families or were neurotics; 7 were hard brain-workers, and 4 inherited the actual disease. In these last 22 the eucalyptus treatment had no effect. Add to these, 4 cases in which the disease had gone to the stage of approaching coma before the treatment had been commenced, and we get the total number of unsuceessful cases. The remaining 15 showed a total disappearance of the disease and, so far as can be judged, are completely cured.—*Medical Annual, 1903.*

ANTIDOTE CACOON.*

NOTE BY DR. REID HUNT, OF JOHNS HOPKINS UNIVERSITY.

I find that the seeds contain a volatile oil which gives them properties similar to those of the balsams,—the famous Friar's Balsam, for example, which was at one time used so much in treating wounds. They also cause vomiting, which will explain in part at least, their antidote properties. Whether these seeds possess these useful properties to a greater degree than other plants already used in medicine or not, it is impossible to say. It is certainly interesting to have them, and if I find an opportunity I shall make a further investigation.

* Fevillea cordifolia.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. MARCH, 1904. Part 3.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and Address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
Hope Gardens.

1904.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. MARCH, 1904. Part 3.

COTTON CULTIVATION.

It may interest those who are thinking of cultivating cotton to know what cultivation was found necessary at Hope Gardens, and the time taken by labourers. The following extracts from the diary will be of some assistance.

The experimental plot is one square chain, and was first well ploughed, and prepared for seed.

Date.	Work.	Time.
26 Aug.	Seeds sown	¾ day
21 Sept.	First cultivation with cultivator worked by one mule ...	1 hour.
	Plants thinned out, leaving only one to each hole	½ day
28 Sept.	Second cultivation with cultivator ...	1 hour
8 Oct.	Third time with cultivator ...	1 hour
28 Oct.	Moulding Plants	½ day
28 Oct.	Commenced flowering	
7 Nov.	Fourth and last time with cultivator, picking out weeds in rows at same time	2 hours
4 Dec.	Weeding	1 day
7 Jan.	Commenced gathering cotton.	

The sowing of the seeds and subsequent cultivation of a square chain therefore occupied 3¼ days, or at the rate of 32¼ days per acre.

In many parts of the Island where weeds are not so troublesome, the cost of cultivation would be very much less. For instance in the Pedro plain, an experimental plot has cost 14s. per acre to clean, 3s. to sow, and 6s. to cultivate, which consisted of hoeing twice.

THE PROSPECTS OF CASSAVA STARCH.

By H. H. Cousins, M.A., (Oxon) F.C.S., Island Chemist.

Through the enterpise of Mr. J. W. Middleton in testing the commercial production of starch at Longville and his public spirit in plac-

ing his results at the disposal of the Board of Agriculture, it is now possible to form some definite opinion as to the possibilities of cassava starch as an industry for Jamaica

The experiment at Longville has been of a tentative character and the actual possibilities of the industry when established on a reasonable commercial scale and with the best machinery and management are far in excess of those directly indicated by Mr. Middleton's preliminary results.

Agricultural Yield.

The returns of tubers per acre at Longville as recorded by Mr W. J. Thompson, varied considerably. Where the cassava had been planted between bananas or under shade the yield was not satisfactory. Eight tons of tubers per acre were obtained on one piece of land, and there is every reason to believe that by thorough tillage and the propagation of the best varieties of cassava a return of 10 tons per acre can be reasonably expected. Mr. Joseph Shore finds that this is a fair return from lands in cassava on the northside.

The cost of production at Longville was 10/6d per ton with an 8 ton crop allowing £1 per acre for rent. I estimate that the cost of production can be reduced to 8/- per ton by reasonable economies and improvements in the cultivation.

The Florida factories pay 18/- per ton for the tubers in the field, the cost of digging and delivery to the factory being about 6/- a ton in addition.

Cost of Manufacture.

At Longville 6 tons of cassava tubers pulped in a small St. Vincent rotary grater yielded one ton of air-dried starch by the West Indian process. The cassava contained about 29 per cent. of starch. The actual cost of production of the starch including the growing of the cassava, amounted to £8 per ton.

By-Products.

The bitty or residual pulp, when dried to a content of 15 per cent. of moisture amounted to a return of $1\frac{1}{3}$ tons of dry material to each ton of starch The composition of this product closely corresponded to that of the meal from the whole tubers sun-dried. Cassava bitty is therefore a valuable food-stuff for cattle or pigs. If we deduct 30/- per ton for the cost of expressing the excess of moisture, drying and bagging the bitty, its net value cannot be less than 30/- per ton to the factory, on a low selling price of £3 per ton. A deduction of £2 per ton on the cost of the cassava starch is therefore apparent.

The cost of production of a ton of cassava starch with a process that only recovers 60 per cent of the total starch in the tubers, is therefore only 6 per ton.

Commercial Prospects.

The starch prepared by Mr. Middleton at Longville was of variable quality at the outset until a satisfactory method of working had been arrived at.

By careful neutralisation of the crude starch with soda, using litmus papers as an indicator, it was found possible entirely to neutralise the organic acids of fermentation that are inseparable from any process of

working on cassava tubers. A high-grade starch free from fibre and dirt was produced and this should fetch anything from £15 to £20 a ton wholesale.

A modern plant which obviated the necessity of peeling the tubers by hand would save £1 per ton in the cost of labour for making the starch. A return of at least 20 per cent of starch equal to two tons per acre should be obtainable.

It would appear that in cassava starch we have a product that will give us double the financial return per acre of sugar under ordinary Jamaica conditions and at a cost of production so considerably less, that there is that margin for profit without which no industry can be generally successful in this Island.

Recommendations.

The chief requirements for ensuring the success of the industry are the following:—

(1) Capital for installing the best plant for dealing with tubers so as to eliminate all unnecessary hand-labour and ensuring the best product possible.

(2) Lands of light texture in a district of moderate rainfall, capable of being cultivated by implements and within easy reach of the factory.

(3) A good water-supply with a system of sand filtration and a covered tank for storing pure water.

These conditions obtain on large areas of alluvial soil on the south side of the island where bananas languish in an average season for lack of water. A system of 'cassava farming' by the local peasantry should be started in connection with each factory.

Experiments to test the most profitable varieties and methods of tillage, cultivation and management should be organised by the Department of Agriculture.

Analysis of Cassava Products from Longville.

Products.		Moisture Total.	Starch Total.	Insoluble fibre.
Starch A.	...	15·62	76·67	0·32
Starch B	...	15·89	76·67	0·35
Starch C.	...	17 54	76·60	0·36
Starch D.	...	17.62	78 13	0·42
Bitty	...	15·13	65·71	3 89
Meal from whole tubers	}	15·08	65·70	2 45

GRAPE VINE CULTURE.

By Rev. William Griffith. *

Within recent years a great deal of attention has been directed to grape-culture in Jamaica, principally, I believe, with a view to putting good fruit on the American market at a time when not ordinarily ob-

* Lecture delivered at the Agricultural Course for Elementary School Teachers, January, 1904.

tainable, or to be had only at very high prices, but up to the present time not much progress has been made in this direction. The natural season with us for grapes appears to be between the beginning of the month of May and the end of August.

During these months excellent grapes, both white and black, are sufficiently plentiful in and about Kingston to meet a good local demand. Outside these months they are occasionally offered for sale in Kingston; but as a rule they are poor, having evidently received no cultural care. This is specially the case with black varieties, which are seldom properly ripened. This, no doubt, is in part the reason why black grapes are so little appreciated by us, and it is a pity, as some of the very best of grapes are black.

The Department of Public Gardens has introduced, and distributed widely just about every table grape of recognized merit, and it is a matter of regret that a better use has not been made of the opportunity thus afforded to secure vines of established excellence. Most of these under right treatment do exceedingly well and are in every way desirable. A few however, and amongst them some of very high quality do not do well at all. Muscat Hambro, one of the most delicious grapes, is an utter failure; it makes good canes, shows plenty of bloom, but the clusters are skeletons.

Gros Guillaume, commonly, but erroneously known as Barbarossa, is most handsome both in bunch and berry but will not fruit here at all, and Lady Downe's Seedling, a black, vinous grape, is subject to black spot which appears on the berries as they begin to take colour, and utterly ruins them. It is regarded in England as the very best late keeping black grape.

The native grape of North America does not succeed with us. Sir Daniel Morris, when Director of the Department of Public Gardens, Jamaica, imported quite a number for King's House Gardens, but none of them did well. I have also tried to grow some twenty different varieties, but doubt if I got twenty grapes from the entire lot. I understand that an attempt to introduce them is again being made. I shall be pleased to hear that the venture has been successful We have one native species, which is widely distributed over the Island. It blooms profusely but I have seldom seen it in fruit. The fruit is black and both bunch and berry are small.

The grape vine succeeds well in low lying situations not much above sea level, and best near the sea. A common opinion for which there must be some ground is that the vines never does well on high ground in the interior. I have, however, seen good grapes grown at Ewarton in St. Catherine.

I know of a vine that bore heavily near Drax Hall in the parish of St. Ann, but I could get no fruit, not even bloom from some vines at Stony Hill. Everything went to make canes which never matured.

I do not, however, regard these facts as any reason why further attempts should not be made in the direction of enlarging the area of successful vine culture in this island.

Anybody can succeed where everybody is successful, but it is an honourable ambition to achieve success where all else have failed.

Vines are usually classified as early, mid-season, and late, accord-

ing to the time when their fruit generally matures, and also to the length of time between starting into growth after pruning and the fruit becoming fully ripe.

Included in each of these classes we find representatives of all sizes, colours and qualities

In the first section are included all the "Frontignans"—white, black, red and grizzly. When well grown there are few grapes that surpass the Frontignans in flavour. They are, however, difficult to grow well, the fruit is tender; and warm, wet weather will ruin the entire crop when ripening; both bunch and berry are small and in the desire for large, showy fruit these excellent grapes have fallen into neglect

"Foster's white seedling" is another early grape, perhaps the very earliest. It is a prolific bearer and when well grown there are few handsomer grapes. It also sets its fruit well and in thinning not less than two thirds of the berries should be cut out which will enable the remaining berries to attain a good size, and no weight of crop will be sacrificed. The fruit is very delicate and tender, and when gathered must be carefully handled or the cluster will be spoiled.

So soon as the fruit begins to colour all watering should cease.

The "Black Hamburgh," as its name indicates, is of German origin. This is an early grape of the highest quality. As a general purpose grape it may be said to hold the premier place among black grapes, although for some reason it has fallen somewhat out of favour in recent years. If pruned at the same time as Foster's seedling, its fruit will mature three weeks or more later than that variety It does best under close pruning; the bunches are more compact and the berries larger. It is impatient of heavy cropping; the lighter the crop the higher, as a rule, the quality and the healthier the vine.

"Madresfield Court" is a grand grape in every way. When well grown, which is unfortunately seldom the case, it is almost without an equal. The cluster is not large but the berries, which are a clear purplish red, are very large and oval. Like "Foster's seedlings" it is impatient of moisture, and when ripening likes a dry, warm atmosphere.

In the mid-season section we have "Alnwick Seedling", "Gros Maroc," "Mrs. Pince's Black Muscat" and "Royal Ascot," all black grapes. In the order of merit I give "Mrs. Pince's Black Muscat" and "Royal Ascot" an equal first place, Alnwick Seedling the second and Gros Maroc the last The first three are all free bearers, Royal Ascot bears immense quantities of small bunches of big grapes, the bunches seldom weighing over eight ounces.. When the fruit is setting not less than 70 per cent of the berries should be thinned out Alnwick Seedling is the easiest to grow and gives less trouble than any grape in cultivation.

Gros Maroc is not a free bearer and is late in coming into bearing. There are, however, few better looking grapes, and scarcely any so poor in quality. It is largely grown principally, no doubt, for its good looks.

Out of the section of 'Late Grapes' we have five that may be said to head the list; three are black, viz., Alicante, Gros Colman, and Lady Downe's Seedling, and two that are white :—Mrs. Pearson and Muscat of Alexandria. Canon Hall Muscat and Bowood Muscat are regarded as cultural varieties of Muscat of Alexandria.

The three black varieties are vinous grapes in contradistinction to the Sweetwater and Muscat flavoured varieties. When fully ripe they have a very distinct Port Wine bouquet. They are all free setters and require severe thinning. Gros Colman is the handsomest in both berry and bunch; Alicante is the easiest to grow and Lady Downe's Seedling, which is a confessedly difficult subject is, when well finished, by far the best keeper and the best flavoured.

They all take on a better colour and preserve their bloom better when grown with some shade from the foliage; the ripening is also more uniform.

Of "Mrs. Pearson" I cannot speak from personal experience; I have never grown it and do not know that I ever saw it growing. It has the reputation of being the latest white grape in cultivation and an excellent keeper.

Muscat of Alexandria is a universal favourite. More vines of this variety are grown in Jamaica than of any other and it is not difficult to grow well. It is by far the best mid-year and late grape in cultivation and well-grown and thoroughly ripened leaves nothing to be desired as a dessert grape.

Where grapes are grown simply for home consumption, and only one vine can be grown, Muscat of Alexandria should be selected. Where there is room for two or more vines and the duration of the supply is desired, Foster's White Seedling for early use and Lady Downe's Seedling or Alicante would be serviceable as a late supply. Alicante is easy to grow, a free bearer and in many ways a desireable variety.

When grown for commercial purposes the varieties selected should be confined (unless the operation is to be on a large scale) to not more than two kinds, one white and one black. By extending the period of pruning and starting into growth over say from the end of January to the middle of March it should be possible to market fruit from the end of May to the end of September or later.

Vines are raised in a variety of ways, from seeds, layers, single buds, and from cuttings taken from healthy fruitful vines. These should be obtained from stout well ripened canes of the present year, the stouter and the more close-jointed the better. In England and America one-year old vines can be bought from firms who grow them largely for trade purposes.

Plants raised from seed are seldom satisfactory, and layering is seldom practised. The almost universal custom in England is to propagate from single eyes. The custom with us is to grow from cuttings with two to four buds, the fewer eyes the better. My method is to use cuttings with two buds planted firmly in light soil so deeply that the upper bud just peeps above the surface of the soil; the bottom bud remains dormant and on the cut surface just under it, the callous is formed from which the roots proceed. All buds, without exception, are produced on the internode or joint of the cane, but roots grow from any part, nodes and internodes alike. By the time the cutting has made a growth of three or four leaves it will have exhausted its stored-up reserve of food and must depend upon the new rootlets for further supplies. If a little good soil is now drawn around the base of the bud from which the new growth proceeds, a number of new

roots will appear at the base of the green shoot, and when the young plant is transferred to the quarters where it is to remain permanently the lower portion of the parent cane may be cut away and we thus secure a young vine which is practically a plant from the bud. The severed portion on which are the first formed rootlets, and the bottom dormant bud may also be planted and, as a general rule, they furnish stout, healthy vines.

When about to plant out a vine, give it a good start by giving it ample root room. A hole three feet in diameter and from fourteen to eighteen inches deep will be ample for the first year. See to it that the subsoil is sufficiently open to allow perfect drainage, if not naturally so, make it so by taking out about a foot more of the soil and adding to it old lime rubbish and coarse gravel. Let the relative position of surface and subsoil be retained. Put no manure at the bottom of the hole; the temptation is to do so; but until the plant has started into growth give no manure at all. A thin top-dressing of half rotted stable manure may then be given and will serve quite a number of useful purposes. It will act as a blanket in cold nights and help to keep the young roots warm; it will also minimise the risk of hurt from sudden changes of temperature as a mulch to retain the moisture in the soil, lessening greatly the labour of watering, and also help to keep the roots near the surface, a very important point, as they will come up to feed. After the vine is established, break up the soil about from three to five feet from the stem, and fork in some rotten manure, and from that time onward leave it alone, confining all cultural operations in this direction to an annual pricking up of the surface to the depth of two or three inches, and giving a top dressing of manure. Do not allow the soil to get hard, but for the vine to thrive the soil must be firm and the roots left undisturbed.

At the time of planting provide a stout straight stick about six to eight feet long with plenty of light lateral growths which must be shortened back to about three or four inches. Wild coffee does splendidly. Up this train the young vine, all that is needed to be done is to give it a start; it will do the rest itself. As soon as it has formed a tendril and taken hold of the support, other things being favourable, growth will be rapid. For the first season the general custom is to allow the vine to grow at will, leaving the terminal growth untouched and only keeping the laterals as they appear pinched back to one leaf. A strong grower so treated will sometimes make from twelve to twenty or more feet of growth during the first season which has all to be cut out the following year and a new growth taken from one of the basal buds which becomes the main stem of the permanent vine.

My plan, which I very naturally think a better one, is when my young vine has reached about eight to ten feet of growth to cut off about a foot of the top and restrict the future growth to the remaining portion, keeping both leader and laterals regularly pinched back. By this treatment I get a cane nearly as stout and as strong as that produced by the first named method at the end of the second season, and quite capable, if permitted, to give a small crop of grapes the second year, that is within a little over a year from the time the cutting was started.

At the end of the first season the grower will have to settle how he will train his vine, whether on the usual flat arbour, trellis, or as a standard. The first is perhaps, all things considered, the best—the second, is the method I personally prefer, and the third is only possible with vines of robust growth.

Under the usual flat arbour system vines seldom receive any attention beyond watering until the time comes for the annual pruning, when sometimes a cart load of worthless growth, which should never have been allowed, has to be cut away. This is generally a disagreeable task. By the second method it is easy to see and get rid of any useless growth as it appears, and thus the whole work of the vine is concentrated on the maturation of the growing crop and the cane necessary for the production of the following one.

Very little is done in the way of producing a good cane until after the crop is entirely removed; then all laterals should be shortened back and any new sappy growth removed entirely, in order that food may be stored up in the new bud and this process is constant during what, to the outward observer, seems to be the dormant season.

As a rule the question of the next year's crop is settled a year ahead. Pruning does not give fruit, it only settles its method of distribution over the surface of the vine when the cane has already been well grown; it does, however, when skilfully performed help very much in securing good canes well placed for the following year.

Two systems of pruning commonly prevail. Each has its advocates and both have their uses.

The older and most generally followed method is what is known as close or spur pruning. This gives good results generally, and in the case of some varieties gives the best results, but some kinds, notably Gros Maroc, Barbarossa, and a few others are practically barren when so treated.

The other, and in certain cases the better method, is to leave from two to three buds on the cane when pruning in spring By this plan larger and looser clusters are secured and the labour of thinning lessened greatly and in my opinion a better and heavier bearing is secured.

The proper time for pruning in Jamaica is any time between the end of January on to the middle of March. If the season is dry and warm the commencement of pruning may usefully be delayed longer But if the year opens with showers followed by warm sunshine, to delay the work of pruning would result in severe bleeding which, however, abates as soon as the buds swell. There is very little to be gained by early pruning before the sap is stirring. A month's difference in the date of pruning vines of the same variety seldom makes more than a week's difference in the time of ripening. The later pruned vines certainly yield the larger and better crops.

As far as possible a vine should each year be pruned at or near the time when previously pruned and this should be not oftener than once a year. From the Frontignan and Foster's Seedling, both very early grapes, two crops can be got under high cultivation, but the vines soon wear out.

After pruning, water should be given very sparingly until the buds begin to push, when a copious watering, using, if available, water from a tank or cask that has been warmed by standing in the sun may be

given. As the new growth develops all weak, ill-placed, crowded or defective shoots should be rubbed off As the buds begin to open the fertile ones can be distinguished from the barren ones by the fluffy red tip that appears in the centre It is wise economy when there is more than one cluster on one shoot to remove one of them. The blossom nearest the main stem will give the most shapely, compact bunch, the flowers further away will give a looser but larger bunch. As soon as growth has been made of about four or five leaves beyond the retained cluster, the cane should be stopped, and all laterals kept in check so as to concentrate everything on the production of fruit

The next important duty is thinning out the young grapes as soon as possible after the fruit has set. Some varieties give little trouble in this direction. Muscat of Alexandria well require a light thinning; Muscat Hamburgh requires none, but Gros Colman and a host of others require from fifty to seventy per cent. of the set berries to be thinned out. The larger number is the safer. Few amateurs have the courage to go this length, and when too late to mend matters they are sorry.

The operation should be performed with a pair of clean, sharp, fine-pointed scissors, and should be repeated when the fruit is about the size of a pea. On no account must the cluster be taken in the hand, but with a smooth bit of wood as fine as a match, and about six inches long, lift up and open the bunch so that the interior berries may be reached and cut out A bone crochet needle with the hooked point removed does nicely. The principal thing to be aimed at is to leave just so much fruit evenly distributed over its entire surface as will make a compact bunch when fully grown, but leaving room for the shapely development of each individual grape.

THYMOL.

Its Use for the Treatment of vermicious Diseases of Horses.

By H H. Cousins, M A. (Oxon.) F.C.S. (Island Chemist.)

Thymol is the most efficient remedy for the various forms of worms and nematodes that attack the horse. The writer has tested it in Jamaica with gratifying results and thinks it worthy of the attention of all horse owners in the island.

Bots are a frequent cause of lack of condition in our horses in Jamaica and other types of vermicious pests are undoubtedly of frequent occurrence.

Thymol has a marked taste and smell and special measures are necessary to secure its successful administration

For horses we have found it most satisfactory to dissolve the thymol in rectified spirits and to stir up the solution with ten times as much sugar. By evaporation at the heat of boiling water, the spirit is driven off and a uniform mixture of thymol and sugar is obtained. This can be easily administered by mixing it with ground corn or even stirring it up with the usual feed of corn or oats. The dose recommended by F. V. Theobald* has been found quite satisfactory, both as regards efficiency and freedom from hurt to the horse:—viz., 15 grains of thymol morning and evening for two successive days. In the

*Economic Entomology, p. 484.

country districts it would be well to give a diet of a laxative green food such as Spanish Needle to promote the excretion of the parasites.

The writer considers, from personal experience with his own horses during the past three years, that the thymol treatment should be regularly administered to all horses once a year, preferably in the Spring. The market price of thymol varies considerably, at present the ruling price is 7s. 8d. per lb. in Germany. One oz at 6d. would provide 28 single doses, so that the actual cost of thymol per horse would not exceed one penny. Supposing one ounce of thymol were purchased this should be dissolved in a little spirit of wine and the solution stirred well into 10 ounces of white "Albion" sugar. If placed in a tin pan and steamed for a short time, the spirit will evaporate and the residue can be bottled for use. The dose for a horse would be one-third ounce night and morning for two successive days.

SUGAR IN JAMAICA.

The following communication from Mr. W. H. Farquharson of Retreat will be read with interest. It was written last November :—

I have in now on this estate 100 acres seedling canes; last crop the average yield of the seedling canes was 40 tons to the acre, some pieces I got as high as 46 tons yielding 3 tons sugar and 2 phns. rum, so that I got three casks to some of the seedling canes.

They grow beautifully here and the average density of the juice was 9° B I do not think they are so rich in saccharine as the Mont Blanc; I am now cultivating this particular cane here, and I must say it has made a great difference in the out-put of sugar. I shipped 734 casks of sugar and rum from 310 acres of canes and the average cost per cask including interest and all charges was just about £7, this including new buildings that I put up in the works

I have a new mill coming out from Glasgow, one of McNiel's 5-roll mill; last year I got by extraction 139 gal. to a ton of canes, I am looking for an increase of 15 %. Too much attention cannot be paid to the importation of good mills, and if this is done, I think we will be able to hold our own at Cornwall Estate where I have a vacuum pan and doubling crushing. The extraction was 159 gals. to a ton of sugar, but of course the out-put of rum was not so good as Retreat in proportion. I am buying canes this year from small settlers at 8/ per ton, delivered at the works and I am expecting to get 5,000 tons; the black people are fully aware of the advantage of planting canes and the industry is spreading very much; in the next Estate to Cornwall, namely Shrewsbury, I have just put up a very fine and improved plant, double mills, green megass furnace, eliminators, and vacuum pan, and we turn out a very high class sugar, testing 98 in the States. I am also buying canes for this estate and a difference in the wealth of the people round about is quite apparent

Next crop I intend to send you every week a statement of the amount of canes ground, the amount of juice contained in the canes, amount of sugar and density of juice, and I would like very much to get some seedling tops from the Gardens. I will be glad if you will send me some of what you consider the best description.

In 1903 at Retreat estate we carted 5,340 tons canes and made 355

tons sugar and 213 phns. rum from 245 acres of canes, a yield of 1,923 gals. to one ton of sugar, 15 tons of canes to one ton of sugar, 139 gals. to one ton of canes, 9½ tons of canes to a cask of sugar and rum, 1,320 gls. to a cask.

In 1903 we carted 7,113 tons of canes from 308 acres of canes, we made 414 tons sugar and 320 phns. rum, 17 tons of canes to a ton of sugar, 1,348 gals. to a cask of sugar and rum.

From Commissioner of Imperial Department of Agriculture for the West Indies to Colonial Secretary, Jamaica.

I believe it would be distinctly helpful to the planters if cane farming were generally adopted in Westmoreland and other districts in Jamaica where the conditions are favourable.

I suggest that the Board of Agriculture might take up the subject and endeavour to guide and assist those who are in a position to adopt cane farming as regular part of the routine in connection with sugar planting in the island.

SOURCES OF NITROGEN TO PLANTS.

In a paper entitled "Recherches sur la Synthèse des Substances Albuminoides par les Végétaux," MM. Laurent and Marchal, of the State Agricultural Institute, Gembloux, give a useful re-umé of the sources of nitrogen to plants. In doing so, they point out that during the latter half of the nineteenth century there was a tendency to overlook the importance of ammoniacal compounds, and to regard nitrates as the only sources of nitrogen to the higher plants. While nitrates are of chief importance, there are many plants, even colonies of plants, such as forest trees and the vegetation of marshes, that must depend entirely on compounds of ammonia for the supply of nitrogen. The authors describe experiments on cress, white mustard, chicory asparagus, white melilot, Persian lilac, and tobacco, and among other conclusions state that sunlight is necessary for the synthesis of albuminoids in the higher green plants, and probably in all green plants, but that amides are produced in limited quantities in darkness and in parts of the plant which contain no chlorophyll. The lower plants devoid of chlorophyll can manufacture albuminoids in darkness, the necessary energy in this case being derived from the decomposition of organic compounds. (*Nature.*)

THE ONION.

Bermuda onions have been most successfully grown in various parts of Jamaica, but only for home consumption. In Antigua an export trade has been established, and efforts are being made by the Imperial Department of Agriculture to extend the cultivation to the other islands. There is no reason why Jamaica should not participate in the trade. Although the seed is not sown until the autumn, it is necessary to order it from the Canary Islands in the Spring to save the increase in price from 3s. 6d. or 4s. per lb. to 8s. and 10s. per lb. later in the year. Sir D. Morris, Commissioner of the Imperial Department of Agriculture will obtain seed, with that required for the other islands. Information as to cultivation and reports on experiments already made are reprinted below from former Bulletins.

The Onion in Jamaica.

(*From Bulletin, Jamaica, August, 1890.*)

Climate and soil vary so much in Jamaica, and the island is so favourably situated for supplying the fruit and vegetable markets of Canada and the Northern United States in winter and spring, that every district could doubtless produce some paying crop.

The onion is the staple product of Bermuda, and His Excellency Sir H. A. Blake has directed that it shall be tried in Jamaica.

In Bermuda the seed is imported every year from the Canary Islands, and a supply is expected immediately for the Department from Messrs. Hamilton & Co of Teneriffe. Some of the seeds will be sown in the Gardens, and small amounts will be distributed at cost price to those who wish to try it in various districts and at different elevations. Excellent onions have already been grown in St. Ann, by Mr. J. C. Stephens at Radnor in the Blue Mountains, and by Mr. Palache, near Mandeville.

There are two varieties grown in the Canary Islands, the white and the red. The white onion ripens sooner than the red, and therefore commands a better price. But as the white variety tends to lose its character and become red, except in the Island of Palma, the seed is obtained only from there, and is more than double the price of the red.

Mr. Peter Henderson, Seed Merchant, New York, estimates the profit per acre as follows:—

"The average product of the onion crop varies very much, ranging from 300 to 900 bushels per acre, the mean being about 600 bushels per acre. The price is variable like all perishable commodities, ranging from fifty cents. per bushel, the price at which they usually wholesale in the New York market in fall, to $1 or $1.50 per bushel for winter and spring prices. The estimate, then, of profit per acre may be given about as follows:—

Manure per acre	$72.00
Ploughing, weeding, and harvesting crop, per acre	100.00
6lbs. seed, average $2 per lb. ...	12.00
Rent or interest on land, per acre ...	9.00
Marketing crop, per acre ...	7.00
	$200.000
600 bushels per acre, at 50c. ...	$300.00
Cost	200.00
Profit	$100.00

This estimate is a moderate one; for if the crop is sold in spring, the chances are that the profit may be two or three times as much."

Sir F. von Mueller, Government Botanist of Victoria, thus speaks of its successful culture in Australia:—"The Onion is a native of Turkestan, succeeds even in equatorial countries, maturing seed fit to germinate, in the hottest desert-regions of Central Australia. As much as 20 tons of Onions have been harvested from an acre of land

in the Bellarine district of Port Phillip. The import into the United Kingdom in 1884 represented £552,000. The export from Victoria during 1887 came to 6,036 tons, valued at £33,482."

The following notes may possibly be some guide to those who think of growing Onions:—

Soil.—A well drained soil is necessary; it should be light rather than heavy, though the latter is more suitable when the climate is very dry. A rich loam is the best soil, and the ground should be as level as possible, so that the Onions shall not be washed out by rains.

Rotation of Crops.—Onions should not be grown in the same spot for two successive years, but alternated with some other crop, such as corn or potatoes.

Manure.—Well rotted stable manure is better than any artificial manure, the sweepings of poultry and pigeon houses, and bat-manure are very useful; night-soil well mixed with dry earth, or lime, or ashes may be used with greater advantage. It should be dug or ploughed in 5 or 6 inches deep before sowing. It is an excellent plan to collect weeds and bush into a heap, burn them and scatter the ashes over the soil before digging or ploughing.

Preparation of Ground.—Whatever the nature of the soil, it is indispensable that it should be broken up fine. The ground must be dug over with a fork or spade, and then the surface made as smooth and level as possible by raking. It may be rolled, as onions form best bulbs in firm ground. For cultivation on a large scale, it will be necessary to plough and harrow. After harrowing, it is recommended by Peter Henderson that the surface should be further levelled by some kind of "smoothing harrow" such as Meeker's Smoothing Disc Harrow, in which the revolving discs pulverise the soil to a depth of three inches much better than it can be done by raking, and the smoothing board which follows in the wake of the revolving wheels makes the surface, if free from stones, smooth as a board, and far better than it can be by raking.

Sowing the Seed.—In the Canary Islands, the seed is sown broadcast in October, and the seedlings transplanted in December during light rains, but transplanting weakens the plants for a time, and if there is dry weather, it is almost fatal. It is much better to sow by means of a drill, and afterwards thin out. In sowing the first row, a line should be stretched. The distance between the rows varies, but 12 inches is recommended. Every ninth row may be omitted to form a pathway. The seeds are sown thinly, and lightly covered by raking. About 8lbs of seed may be used to the acre.

Cultivating.—Deep hoeing is not advisable, as the ground must be kept solid, but when the lines of young seedlings first make their appearance, a hand cultivator may be applied between the rows. Weeding and thinning should be done by hand. The distance between the onions in the rows is from 4 to 6 inches. When the thinning and weeding is done, the surface should be thoroughly broken up by using a wooden rake across the rows.

Harvesting takes place in the Canary Islands during April and May. When the bulbs have attained their full size, the leaves are bent down at the neck of the bulb by the back of a wooden rake. This checks

the flow of the sap, and causes the leaves to decay, and the bulbs to ripen more quickly. When the leaves wither the Onions are taken up and left lying for 3 or 4 days to dry in the sun with an occasional turning over: they are then strung into ropes for sale.

Onion Cultivation in Egypt.

From Bulletin, Jamaica, Aug., Sept., 1894.

The onion crop of the valley of the Nile is of great importance, and brings an increasing amount of money each year to Egypt, as onions are shipped in immense quantities to England, France and other European countries, and to the United States, where they find a ready sale at good prices. The quality is stated to be so excellent, that efforts are being made in other countries to grow onions from Egyptian seed. The United States Agent and Consul-General at Cairo says that in all departments of Egyptian agriculture, watering is accomplished by means of irrigation from the Nile, either directly or from canals. The most popular Egyptian onion known as *Baali*, is grown in yellow soil, sparingly watered while the bulbs are maturing, that they may stand a lengthened sea voyage with little risk of sprouting. There are two stages of cultivation, the first covering the season of the sprouts for transplanting. Towards the end of August or the begining of September, the land intended for the onion crop is irrigated from the Nile. After letting the water run off, it is left to dry until the first ploughing when the plough-shares penetrate not deeper than four fingers breadth. All clods of earth are broken up and pulverised, and the land is divided into plots about ten feet square, and stirred lightly with a mattock—the favourite implement of the Egyptian farmer, which is double headed, one side being broad, like an adze, and the other like a pickaxe. The seed is then scattered freely and evenly at the rate of about two bushels to the acre. After sowing, a plank is passed lightly over the soil to cover the seed and bring the plots to the same level. The plots are then irrigated, the islets along the Nile being watered four times, and the raised land six times. The first irrigation takes place immediately after sowing, and the water is completely absorbed; a second, and very light watering is given as soon as the plants appear above ground, and the borders of the plots are sprinkled If the seed is planted in raised land, manure is applied, but if sown in low ground there is no need of manure; the Onions ripen in the first fortnight in October. The second stage covers the period from the transplanted sprouts to the mature Onions. Land intended for *Baali* onions is soil of good quality, with no weeds or grass, or yellow land of the same quality, and damp enough to allow the crops to grow and ripen. It is irrigated in September, and it is ploughed three times, the plough-share penetrating to a depth of about eight inches. After a third, and last ploughing, the onions are set out in furrows, at a distance of four inches apart. The furrows resemble wheat furrows, and the earth covers the onion in the second furrow. In ploughing the last time, the cultivator plants the bulbs in the furrow; the plough returning in the second furrow covers them. The stalks, or tops of the seed onions emerge from the soil to a height of four fingers breadth or more. Every 20 days the weeds are pulled out, in order that the onions may be clear and allowed to

develop. In the month of April the tops die, and the onions are pulled. and when perfectly dry are packed in coarse sacks and sent to market. *Baali* onions in their second stage are never watered directly. *Miskaoui* onions absorb so much moisture from the frequently irrigated ground in which they grow that they are seldom exported. They are sown in the same way as the *Baali*, that is, the sprouts are used as seed, and any kind of soil can be used. The land is irrigated at the beginning of September, and, after the water has run off, it is left to dry until it can be ploughed. It is ploughed twice, and divided into plots 10 feet square, each furrow being a little over two inches deep and nearly five inches wide. The plants are laid in the furrows at distances of four inches, and the water is immediately let in. The second irrigation takes place in twelve days, and the third in 24 days; after this, the soil is watered every eight days; the ground is then left ten days without watering, and the onions ripen and are unearthed; they are known to be mature when the tops become dry. The cultivator plants the sprouts in the furrows, head downwards, burying them to the depth of four fingers' breadth.—[*Journal of the Society of Arts.*]

Bermuda Onions in Antigua.

By Archibald Spooner.

From Bulletin, Jamaica, May,—July, 1898.

Ths cultivation of the White Bermuda Onion is gradually being extended here, and in a few years I think will form an important article ef export. The secret of success seems to be the choosing of rather poorish clay loam soil containing a fair amount of lime, such as a run-down cane piece, and avoiding any manure, especially artificial manure; on rich land or where manure is used, onions will hardly form bulbs, but all the growth goes to leaves and stems. I have grown onions in Victoria, Australia, where it was always held that heavy manuring was necessary, but here in the tropics the reverse seems the case.

The following hints may be useful. Use only "Bermuda onion seed" either "red" or "white." The seed comes from Teneriffe; neither Spanish, Italian nor Madeira onion seed is of any use in Antigua, the plants never bulb satisfastorily, but grow either too thick necks or divide up the roots like shallots. The best soil is rather a heavy calcareous loam that crumbles on the top to a fine mould by the action of sun and rain, and is thus easy to weed. The land must not be too rich, a cane piece from which old ratoons have been cut is quite rich enough without any manure. Of course it must be properly drained. On land of the above description, manure, especially artificial manure like sulphate of ammonia or guano, does harm, the onions nearly all running to top and not to bulb. The seed should be sown in boxes in a good sandy loam, quite shallow not more than a quarter of an inch of soil covering the seed, and special care should be taken to compact the soil round the seed, for which purpose the rows may be pounded with the edge of a brick, the earth may then be watered and kept damp but not too wet or many of the young plants will die; in seven days most of the seed will be above ground. Never use any manure, especially dung manure in the seed boxes, the young plants are very liable indeed to be killed by nematode worms and these are always worst in soil enriched with dung. The young onions come up all right, but when about 1½–2

inches high, shrivel up just at the ground level and die. If you cannot get soil free from these pests, put your earth into an oven and bake it before sowing the seed: this is a good plan any way, as the weed seeds are killed too. Plant the young plants out when about as thick as a slate pencil, about 6 inches apart in the rows, and the rows far enough apart to work a hand hoe between.

The best month for sowing seed here is October, planting out the young plants in November. The onions will be fit to pull about March, when the rains have stopped, and they can ripen up in the dry soil. When the leaves are yellowish, the onions can be pulled up and left on the ground for a few days to harden, then moved to a shaded but windy place and thoroughly dried until the tops are quite brown and can be pulled off without showing a green centre shoot, they will then keep for 2 or 3 months at least, in a cool and airy place, as long as they are not piled up in a heap or in barrels. Several caterpillars or moths attack the plant here at all stages, especially a black caterpillar; look out for these about a week before new moon, and pick them off.

Reports.

From Bulletin, Jamaica, October, 1891.

At Hope Gardens half an acre was sown, and produced 201 lbs. weight of onions. At Castleton a square chain yielded 20 lbs. At Cinchona the seedlings were almost completely destroyed by grubs, which came up out of the ground at night, and ate the young s oots. A correspondent has kindly sent the following recipe for killing grubs, which proved successful:—"For destroying grubs or cabbage worms:—1 lb. Alum dissolved in 3 gallons of water. Dissolve in boiling, and fill up with cold. Water the gronnd with this every two or three days."

Mr. C. L. Walker writes: "The Bermuda Onion seeds that you kindly let me have turned out well and gave an enormous return. . . . They were manured with old stable manure, and thinned out to about 8 inches apart. I did not weigh all the onions, but many weighed from 8 to 10 ozs. They were grown at Ballard's Valley. Annual rainfall 75 inches. We had very dry weather in St. Mary at the fall of the year. Elevation about 340 feet. Soil, heavy black."

Mr. Arthur Douet, St. Ann, states that he sowed about 100 seeds, and got 4 lbs. weight of onions. The seedlings were transplanted. Soil, red earth. Elevation 1,500 feet. Annual rainfall 75 inches, of which 10 inches fell during the months the onions were growing. Some of the seeds were given to neighbours, but none grew.

Mr. A. W. Watson Taylor, Haughton Grove, Hanover:—A few rows gave a satisfactory return of onions for our own use, but I noticed that during the height of the dry weather watering did not seem to keep up the growth.

Mr. Augustus Thorp, Mahogany Vale:—The onion seed planted in January was 6 ozs., covering 1½ chains of land in 9 inch apart drills. The yield upon digging in middle of May was 36½ lbs. Owing to the continued dry weather with the exception of one or two light showers, the onions did not obtain their full growth. The flavour was good and pungent. Had weather been favourable the result would have been most satisfactory. The elevation here is 1,700 feet above the sea-level, and the average temperature 75°.

From Bulletin, Jamaica, June, 1892.

Mr. C. L. Walker has been most successful in growing onions at Ballard's Valley, St. Mary, some of the bulbs weighing as much as 1 lb. The seed was "Pale Red Bermuda," purchased from Mr. Ed. D. Kinkead (Kingston).

Mr. Walker writes :—I sowed 1s. worth of onion seed, the weather being very heavy at the time, I suppose, one half was washed away. No account was kept of the weight harvested but I estimate that when all have been taken up 3 beds 14x4, 14x3, and 15x12, will yield say 200 lbs. To date a great many are not yet fit, this I think is from being planted too thick and were not thinned enough. Last year the transplanted onions did as well as these.

I planted the seed without paying much attention to the cultivation of them, the beds were not highly manured, just a small portion of stable manure being used as the soil is rich.

From Bulletin, Jamaica, December, 1893.

Seeds were received from the Botanical Gardens, Saharanpur, Northern India, of two kinds, "red onion" and "white patna," and they promised well. A small packet of seed of the variety known as "White Queen" was sown at the Hill Garden and the onions gave promise of being exceptionally fine. This variety has been grown by Mr. Stephens, of Radnor, for some years and he speaks highly of it. The onions seldom fail to bulb, and grow to a large size, often weighing as much as 16 ounces.

One ounce and a half of seed of red and white onions from Teneriffe, as supplied for Bermuda, was sown in King's House Gardens and afterwards transplanted into a bed of good rich soil. A crop of 70 lbs. in weight was the result. None of the onions were very large, but were of fair size for ordinary use.

Mr. C. Plummer, Kingston—The onion seeds turned out very fairly; about half the seeds sown grew, and I transplanted them early in February; every one bulbed nicely, although the ground was not specially prepared. I reaped a satisfactory crop. Some measured 8 inches in circumference. This I consider very fair, seeing we had no rain at all to speak of in the city during the time they most needed it.

Mr. E. Griffin, Kingston (Montpelier)—Onion seed germinated well, but was swept away by heavy rains. I had sown some onion seed which came direct from Bermuda, but so far as germinating is concerned that I obtained from you was far superior, and I have no doubt, if the river had allowed me I would have grown some first class onions.

Rev. M. A. Collins, Kingston—I sowed the seed in the rainy season and only a few of them came up. Several grew to a good size. Under proper conditions, I think onions will do well here.

Mr. B. S. Gosset, Farm Hill—Weight of 3 onions grown, 21 oz., 11 oz, and 7 oz. respectively.

Mr. F. H. Barker, Retreat—From the packet of seed (½ oz.) I got 20 lbs. of very fine onions and would have got much more, but during my absence the onions were thinned and transplanted, when the dry weather set in and all the transplanted ones died. The seed was planted early in November and the onions were taken up early in April. The trial has satisfied me that onions can be grown here with profit, and I intend trying the cultivation on a larger scale this fall, if I can procure seed.

Mr. M. H. Edwards, Linstead—The seeds sprouted well and were coming on nicely, but just as they were about to form bulbs my peafowls got in and destroyed them all.

Mr. A. A. Stewart, Walker's Wood—We had such heavy rains for weeks after planting that the greater part of my seeds were washed away—what survived gave very good onions, large and mild in flavour.

Rev. G. McNeil, Shooter's Hill—We succeeded nobly with the seeds. In spite of the severe drought which followed the sowing, they bore excellently.

Mr. W. F Bailey, Shooter's Hill—The seeds failed to produce anything like good results. Plants came out excellently but were all seriously affected by the dry weather in December. I think April to May would be a much better time to sow the seeds here.

Mr. T. H Grant, Shooter's Hill—The plants grew to the height of about one inch, when the drought set in, and most died. From those that lived I got about one quarter pound The bearing was fair. Had the drought not troubled them, I expect I would have got a few pounds of onions.

Rev. J. Reinke, Mile Gully—The seed was planted as nearly according to directions as possible, but I got nothing. A few of the seeds came up but soon died off. Those I formerly succeeded with were planted in May, having been started in boxes.

Mr. J. Shearer, Duncans—Seeds sown at Vale Royal failed entirely apparently on account of insects in the soil; those sown at Cave Valley Estate in St. Ann, 1,800 ft. alt., are growing fairly well. I have had some bulbs from them about 2 inches in diameter and of good flavour.

Mrs. Noble, Little River—The onion seed has turned out successfully I think. I have 5¼lbs., some quite large and full flavoured, some measuring 5 inches in circumference I certainly think with perseverance one would find them very remunerative.

Mr. W. Baillie, Walker's Wood—The seed germinated well, and made a good start, but the continued dry weather has checked them, and the bulbs are on the whole small, with here and there a fair-sized one.

Mr. C. L. Walker, Walker's Wood—The seasons being heavy in October last, most of the seeds were washed away, but some grew and produced very good onions.

Mr. John R. Braham, Moneague—The plants bulbed freely, but were not large, being what I can best describe as pickling onions, and ranging from ¾ to 1½ inches in diameter. I consider my attempt therefore a commercial failure. Eschalots would have decidedly paid better.

Mr. J. M. Cover, Brown's Town—The onion seeds have turned out first class considering the sharp drought we have had, and I have taken out some which measured 3 inches in diameter. I have no doubt that with proper cultivation and a good supply of liquid manure we could turn out onions just as large as those from America.

Mr. Geo. Lannaman, Brown's Town—I sowed the seeds and had them transplanted according to the directions in the Bulletin, and they were coming on nicely, but the heavy rains in November and the early part of December destroyed them completely.

Mr. W. G. Groves, Ocho Rios—The seeds I got last year from you turned out very well and yielded a good return.

Mr. C. N. Heming, Davis Town—The October rains washed most of the seeds away, but a few grew and produced fairly large onions.

REPORTS.

From Bulletin, Jamaica, April, 1895.

Mrs. Gunter, Kingston.—Seeds were planted in April. The weather was very dry and they did not do well.

Revd. A. A. Hedmann, Clifton, St Andrew.—Although the greatest care was taken in ploughing, manuring and drilling the land, and the young plants were well protected from destructive grubs, the result has not been at all satisfactory. The onions matured very quickly but the return was scarcely worth the trouble of reaping, the largest onion being not more than $\frac{3}{4}$ of an inch in diameter.

Mr. J. Stephens, Radnor, St. Thomas.—The Indian onion seed from Botanic Gardens, Saharanpur gave a very useful crop of small onions of very good quality. The seed heads gave sets with me (instead of ripe seeds) These sets on being planted increased well; on the whole the onion is a useful family onion.

Mr. W. A. Sabonadiere, Hagley Gap, St. Thomas.—The onion seed germinated very well. It was sown in December but owing to absence from home the onions were not transplanted till the end of February. From March to May onions were gathered fit for use. Many were very small but every one made a bulb, the largest may have weighed 4 ozs.

Mr. C. Stewart, Bath, St, Thomas.—I planted the onion seed which I received last year. They grew well. I transplanted them, but the heavy rains in October destroyed the whole bed.

Revd. D. W. Bland, Hagley Gap, St. Thomas—Considering that the soil, in which the onion seed was planted, was not as wall prepared as it ought to have been, I think that I have been very successful with it, obtaining bulbs averaging 8 ins. in circumference, with 2 ins. of depth,

The onion is mild and delicate in flavour, and is a good keeper.

Mr. Clare, Hagley Gap, St. Thomas.—I am sorry to inform you that the onion seeds did not prove a success; as soon as they grew to about 6 in. high, grubs destroyed most of them.

Mr. C. H. Levy, Serge Island, St. Thomas.—Two beds were prepared twelve feet in length by four feet wide, on new ground; with a moderate amount of well rotted stable manure forked in, drills drawn two and a half inches deep allowing nine inches between the rows.

The seed was sown in the beginning of February and covered with fine soil, and watered daily, weather being very dry at the time.

The young plants came up in about five days but grew very slowly for the first two weeks. In fact you could hardly discern if they made any growth at all.

When the plants were six inches high, they were thinned out three inches apart and transplanted instead of being thrown away as an experiment to see what they would do.

As soon as the bulbing commenced it was found necessary to mould them as the sun scorched the outside skin, owing to the constant watering the soil was washed away. They were watered daily, and with very weak liquid manure in addition twice a week until commencing to ripen, then withheld altogether. The crop was taken up early in May and weighed in all thirty pounds. The plants that were transplanted did not succeed anything worth mentioning, not producing one

twentieth part in weight of those left in the seed beds although occupying three times the space of ground.

In my opinion the seed was sown too late in the season for this elevation or the result would have been better, as they ripened prematurely and did not keep sound very long

Mr. C. H. Grossett, Port Antonio, Portland. –I have much pleasure in reporting that the onion seeds you very kindly sent, were planted and grew, but just then we had unusual heavy rains which destroyed them.

Mr. Davies, Cedar Valley Portland.—The onion seed, I received from you, I planted, and they are growing well. They would thrive better if I had ploughed the earth before planting them.

The onions I observe bulb quickly when not deeply planted.

Mr. M. J. Bowen, Retreat, St. Mary.—The seeds did not all grow as they were sown just in the rainy season. I got a few nice large ones, however, some weighing about six ounces.

Mr. T. Williams, Retreat, St. Mary.—Some of the onions grown weighed half a pound, but most of the seeds were lost in the rains.

Mr. Ernest H. Kerr, Port Maria, St. Mary.—I am sorry to say I was most unsuccessful with the onion seeds you kindly sent me : I planted twice and got no return. The first planting was on rich soil well ploughed for Banana plants. The second on forest land prepared for Bananas. My idea was to get in a crop of onions before the bananas came in.

Mr. Barker, New Ramble, Retreat, St. Mary.—The onions have not done so well as last year. Of the first two packets only the white seed grew, and bore some very fine onions, but as they did not all come in at one time, I could not keep account of weight.

The last seeds have grown well, but I fear the very hot weather we are having will prevent their doing well.

Mr. A. J. Webb, Laughlands. St. Ann.—The onion seed came up well but did not bulb to any size.

Mr. Alex. Hopwood, Brown's Town, St. Ann.—The onions did not bulb larger than eschalots. I planted them in a bed well mixed with stable manure, and the rainfall was continuous up to the time of bulbing.

Mr. C. L. Walker, Walker's Wood, St. Ann —On account of the heavy October seasons, a great deal of the onion seed sent by you was washed away. I however made another trial of a few I had left which gave a splendid return, many of the single onions weighed over 16 ounces ; those that grew in clusters weighed over 21 pounds.

Mr. C. Costa, Brown's Town, St. Ann.—I divided the onion seed you sent me last year into 3 lots for planting at different times, to see which did best.

The first lot planted in November did remarkably well, produced a good crop, and some of the onions were exceptionally fine.

The other lot of seed planted in December and January did badly.

Mr. A. J. Hart, St Ann's Bay, St. Ann.—The Bermuda onion seeds sent me were planted and turned out well, the onions varying from 3 to 10 ozs.

Mr. Townend, Laughlands P.O., St. Ann.—The onion seeds were not successful. I prepared the ground well, but I think the seeds were sown too late in the year although well watered through the dry weather, only a few poor specimens survived. I intend to try again.

Mr. T. W. Fletcher, Ocho Rios, St. Ann —The onion seeds were

distributed amongst several small settlers—what was sown grew well but the drought overtook them and the parties having no means of watering, they died off except a few pla ts which brought fine onions.

Mr. B. E. Fullerton, Duncans, Trelawny—The onion seeds you sent me last year were sown and sprouted freely, and as the weather was favourable I got a fine crop Some of the bulbs measured fully 8 inches round. Both varieties—red and white—did well. I made ready sale.

Inspector McLeod, Montego Bay, St. James.—As I have only a small garden I sowed a small portion of the onion seeds you sent me in a box. The plants came up thickly, and when 3 inches high I transplanted them 3 inches apart into two well manured beds, 14 × 15 feet, I watered them daily in dry weather, and all the plants grew well, and bulbed, many of the onions measured 12 to 13 inches in circumference, and weighed 8 to 10 ounces each. Some single plants produced clumps of 2 and 3 onions weighing from 18 to 20 ounces.

I reaped the crop in February and March. I sowed the rest of the seeds but they did not germinate having been kept too long.

My garden is within a mile of the sea, and 2,000 feet above sea level.

Mr. L. A. W. Stradling, Sav.-la-Mar, Westmoreland,—The seed germinated fre ly and the plants seemed to be vigorous and healthy, until they were about four or five inches high when they turned yellow and withered away. The next time that I try onion seed growing here I will either take the soil from an old pigstye, or cattle pen, or use bone or blood artificial manure.

Mr. A. C. Martin, Cross Keys, Manchester.—The onion seeds you sent me have turned out well. I only planted half the quantity and hope to reap over 30 lbs. weight of onions, some of the bulbs measure 10 inches in circumference.

Mr. A. W. Heron, Cross Keys, Manchester.—The seeds I planted in November last and am glad to say got a favourable result. I merely planted them in a firm red soil richly manured with sheep manure and made in drills Elevation of property 2,000 feet above sea-level.

Mr. C. P. Nosworthy, Pratville, Manchester.—The onion seeds you sent me were sown last October very thin, and I have now 50 yards of very decent onions, a little larger than pigeon's eggs, which I expect will show well after a little rain. I gave some to my Ranger and they have succeeded well.

Mr. Wright, Watson's Hill, Manchester.—The onion seed sent me turned out pretty favourably, considering the severe drought which lasted from December to April Manuring could not be carried out as directed in the Bulletin, neither could any transplanting be done. The latter on account of drought.

A good number of seeds grew, but soon after some died. Several of the onions measured $2\frac{1}{4}$ inches in diameter, some others $1\frac{1}{2}$ and the rest were like 'eschalots.' With much more favourable weather and careful manuring, onions would thrive well here.

Miss Gordon, Mile Gully, Manchester.—In February I planted the seed in a small piece of a vegetable garden. The spot was well prepared with good soil and manure. After 4 months the result was some small onions, the size used for pickling. The flavour was good and probably had the seed been sown at the proper time the result would have been more satisfactory.

Mr. H. Archer, Old Harbour, St. Catherine.—The seeds all took well and came to perfection about 22 weeks from planting and gave a fair crop.

From Bulletin Jamaica, Oct. 1895.

Mr. W. Chisholm, Halfway Tree.—The seeds I got from you were divided in two lots; the first was sown in September or October, but all the plants were destroyed by the very heavy and constant rain we had last year. In November I put out the balance of seeds and after the plants were about 6 inches high I transplanted every one with the result that the onions were quite a success both in size and quality.

We had onions of all sizes some measuring over 11 inches in circumference and were praised by all who tasted them.

Mr. W. A. Sabonadiere, Cedar Valley.—The onion seed planted early sn 1894 did not come up very well, a few came in too quickly and none were more than 2 or 3 ozs. in weight, in the autumn some were transplanted which are doing much better and will soon be fit for use. The seed sown in December, 1894, came up much better and the young onion looked promising. Of those transplanted one onion just gathered weighed 1 oz, and 6 one quarter of a pound.

Mr. F. H. Burker, Retreat.—These seeds were sown on 11th Dec., '94 and grew very well and would have produced a good crop but for the unusual dry weather since Dec., 1894. The crop has not yet been taken out of the ground but there are some very good sized onions among them.

Mr. Alex. Hopwood, Brown's Town.—The crop of onions this year is very poor, very small in size, and only fit for pickling. The seeds were planted and treated the same as the previous lot, which yielded onions up to $\frac{3}{4}$ lb. each. Cannot account for the failure. The seeds were sown a month earlier than the previous year, otherwise the cultivation was the same. The seeds of the Indian Onion grew beautifully, but the onion from them are very small. This description of onion has never done well with me.

Mr. Costa, Brown's Town.—The onion seed that you kindly supplied last year have given a good return of onions and particularly the red onions. I planted my onion seeds last year in Nov. and did not transplant, the soil was ploughed up with a hoe, a small quantity of manure added, and little furrows $1\frac{1}{2}$ to 2 inches in depth made with the point of a stout stick into which the seeds were sown, soon as the onions began to bulb they were moulded. From the results of my experiments I conclude Octr. and Novr. are the only months in which it is advisable to plant onions. For the past two years I have done so well with the small quantity of seed supplied me from the Gardens, that I am thinking of going in for the cultivation to some extent.

Mr. C. L. Walker, Walker's Wood.—The Indian Onion seed came up rapidly, made perfect heads, and were smooth and perfect but small about 14 to the lb. flavour perfect. I am of opinion that the Indian Onion is the best for Jamaica. They came to perfection in 9 weeks, and were then fit for the market.

Sergt. Carr, Cave Valley.—The Bermuda Onion seeds which I received some time in last year were delivered to some of the small settlers, and they throve most beautifully with some of them, and they are now getting ripe.

Mr. T. Kemp, Cave Valley.—The Indian onion seed I received in

dry weather, and sowed it in the open ground watering the bed every evening. The seeds sprang beautifully, and grew rapidly until about 4 inches high. We then had very heavy rains and the ground though expansion rose 2 or 3 inches leaving only the tops of the leaves above ground, this seemed to put a check to their growth as they grew very little aftewards, and when ripe were only fit for pickling. The Bermuda Onion seed I sowed in a box and when about 2 ins. high transplanted them into a prepared bed, they grew very rapidly and came to a good size, the best weighing 8 bulbs to a pound. I am convinced that had the Indian seed been treated in the same way, and had the Bermuda seed been sown earlier better results would have been obtained. In transplanting I put the plants 4 inches apart so that per acre they would yield a very good return.

Mr. J. H. Mills, St. Ann's Bay—I am glad to report that the onions turned out all that could be desired, so much so that I intended writing to ask you where I could get seeds of the description you sent me to buy—I bought seeds in Kingston but they were not good—I got from the seeds you sent me single onions weighing 14ozs.

Mr. B. E. Fullerton, Duncans.—I have to report most favourably on the onion seeds you sent last year. They were sown in October in a well prepared bed made on a spot where I had previously made some farm yard manure; the sprouts came forth freely and healthily, transplanting was done at the end of November on the few early days of December, and a splendid crop reaped in March—bulbs well formed as you will see from the samples sent you herewith. I think from the results of my experiments for the the three successive years past I am in a position to pronounce the locality well adapted to onion culture. Of course as is the case with most objects of culture, much trouble, attention and care are needed to secure satisfactory results—not to mention favourable seasons.

Mr. R. N. Heming, Davis Town.—The seeds you sent me have turned out very successful Some very fine large bulbs have been grown and on the whole the returns received are very much better than the previous year.

Mr. J. H. Bonello, May Pen.—I am glad to state that the onion seeds grew nicely and would have given a splendid return had it not been for the drought which took them.

Mr. H. Jackson, Mandeville.—I have much pleasure to report that the Bermuda onion seeds I got from you turned out a success. I grew them on red soil highly manured with ashes and stable manure mixed. Some I manured with stable manure alone, but those did not turn out as well as the others with the mixture. I find they thrive best on land that has been previously cultivated; I drilled seeds about a foot apart, aud sowed an inch apart in each row, When the seedlings attained the height of 4 inches I thinned them, thereby giving them a space of about 3 inches. After this I did nothing in the way of cultivation, except keeping the soil free from weeds. I had to water freely on account of the severe drought we had at the time I planted. Most of my onions weighed $\frac{1}{2}$lb. but they averaged about 6 ozs. Seed was sown first week in November and bulbs were taken up in March. I would like a few more seeds if you can spare them to make another trial.

M. A. G. Heron, Cross Keys.—The Bermuda onion seed you sent me

were planted last October and sprouted feirly well, but owing to the dry weather commencing with me from middle of December until March 1895, the bulbs were very small taking 50 to 60 to the pound. The Indian onion seeds you sent me were planted in Oct. last, but did not sprout so well, a good deal of the seeds must have been bad. Owing to the dry weather, being several months without rain, the bulbs were very small, but of a good flavour, and rather finer than the Bermuda onion.

Mr. A. C. Martin, Cross Keys—Both the Bermuda and East Indian onion seeds were sown in Oct., 1894. The Bermuda sprouted well and the bed was thinned out, seedlings pulled up were transplanted into another bed, altogether 152 square feet was planted out and by the end of March, 1895, I gathered 44 lbs. of well cured onions some of which I exhibited at the Mandeville Flower Show in May and obtained first prize.

The East Indian seed did not sprout well and in consequence I did not thin out seed bed. From 57 sq. feet of land I gathered 14¾lbs. of well cured onions by end of April, 1895. The bulbs were not very large but of fair size and on the whole there were not many small onions. From my experience I think the month of August, September and October best for sowing seed. I find the seedlings stand transplanting well and this should be done when they are about 4 inches high, when kept until they are taller they die more readily. I have tried to induce the small settlers in my neighbourhood to cultivate onions offering them seeds and plants, but it seems to be a difficult matter to get them to attempt anything new. I will be glad to get more onion seeds as soon as you have any.

Mr. C. P. Nosworthy, Newport.—The onion seed was sowed last October and came up very regularly, but the extreme drught ever since has rather perished them—they are, however, now beginning to recover strength and after a little more rain I will transplant all the thinnings.

Mr. C. T. Dewar, Duncans—I have seen a bed of onions in Duncans grown by the Schoolmaster, Mr. Fullerton. They are really good and if always as successful they would be a very paying item in a market garden.

Mr. J. R. Reece, Pedro.—My first lot of onions failed owing to too much rain, the second, owing to drought.

Mr. John Davidson, Bellevue—I have been very successful with the onion seeds you sent me; there are a few smallish ones, but they measured in circumference as a rule 7, 8, 9, 10, 11, and 11½ ins. The crop is (for quantity of seeds) a large one and taste and flavour absolutely delicious

Mr. R. A. Walcott, Mandeville—I gave Mrs. Swaby about a quarter of a pint of the onion seed you imported for me. She sowed them at Newark in Manchester in October last. The rains washed out a very considerable portion of the plants, but for all that she reaped a crop of 186 lbs. of fine onions in February this year, and she readily sold them in Manchester at 6d. per lb. The onions were not very large, but of fair size and excellent flavour.

[Issued 21st Mar., 1904.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. APRIL, 1904. Part 4.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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Hope Gardens.

1904.

JAMACIA.

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Vol. II. APRIL, 1904. Part 4.

NOTES ON THE HANDLING AND PACKING OF FRUIT.

By R. L. Young.

Citrus Fruit.

In the cultivation of fruit the first thing to learn is care in handling of the produce, and one of the greatest difficulties is to supervise the labourers, and see that they exercise proper care in gathering the crops.

Let me commence by stating that most of my experience in handling fruit of all kinds, more especially of citrus fruit, has been in cultivated groves; as I have never had any satisfactory results in handling our wild citrus fruit, owing to the inability to control the labourers, whilst scattered all over the pastures In a cultivated grove the trees are followed row by row, one person with clipping shears with round points, meant for that purpose, whilst a child follows with a padded basket to receive the fruit. Any fruits slipping from the hand or touching the ground ever so lightly are rejected. The fruits are not taken from the trees in one picking, the thoroughly ripe ones are selected first; preference being given to those that are clean, bright-coloured, well shaped, firm, smooth oranges, as most likely to command good prices, at the same time by this method the trees are lightened up, and assisted to bring on the later fruit. Another advantage of our cultivated over the wild fruits, is that they can be stem-cut right away from the trees, thereby avoiding the very common danger of tearing the skin, when the gatherers have to climb the trees to pull them. The fruit should be picked at least three or four days, and spread out in the packing house, before attempting to pack them, allowing the rind to shrink and lose its surplus moisture. If packed immediately after picking they will sweat in the boxes, even at an ordinary temperature, and the contents of the box become damp, and are in danger of rot and decay. Another advantage gained by allowing the fruits to shrink, is that the skin becomes more pliable and yielding, and the fruits are better able to stand the pressure of pack-

ing, at the same time bringing to light any imperfections, such as prickle marks, scratches, or bruises, which can be rejected forthwith.

The packing of oranges has now been reduced to a fine art, and the box usually used is the standard one of 26 × 11½ × 11½ inches, boxes being much preferred to barrels, owing to greater convenience in handling them.

The oranges are then wrapped and packed. The old system of bringing one orange directly on the top of the other has been discarded. They are now alternated, so that each orange comes over the space between two, giving the whole more solidity and elasticity and the fruit as a result, sustains less injury from rough handling.

The sizes of the oranges are regulated, a big and a small one never being put in the same box. For this purpose a sizer is used which helps to simplify matters very much, boxes being arranged to hold 96, 112, 126, 150, 176, 200, 216, 250.

The fruits are then packed closely and firmly in the box, so that there will be no room for them to tumble about and be bruised. A thin cover is then placed on, and held in position by two thin cleats across the top ends, the centre of the top being left free.

The distinguishing brand is then placed on either end, and the number contained in the box is carefully printed on the side.

Pine Apples.

It is necessary to cultivate Pine Apples to get them to come to anything, and when they do come to perfection, they are very much easier to handle than almost any other fruit. They also should be cut at least four days before attempting to pack, they are then drained by turning the tops down, resting the Pine Apple between two pieces of wood. Care must be taken not to hang them by the stem, neither must they be made to stand on end; but if picked in dry weather they do not require so much attention.

Crates should be deep enough only to hold one row, and the fruit should be properly sized, all of a size being packed together, and no crate being allowed to contain a large and a small pine. The stem should be cut not shorter than one and a half inches and no growths allowed to remain around the base of the fruit, care being taken to remove them, without hurting the fruit or stem. The tops also must be carefully preserved, as they help not only to adorn the fruit but considerably enhance the market value. There is a special paper prepared for wrapping pines; excelsior is often used but not so satisfactorily.

Bananas.

Banana cultivation is one of the easiest in the West Indies, but in the gathering of the crop lies the most difficult part of this business On cultivated land they should give fruit from twelve to fifteen months at the outside. The bunch must be cut with a portion of the stem retained for better convenience in handling, the terminal bud being removed.

For the American market they should be cut at least eight or ten days before they ripen, whilst for the English market it should be not less than fourteen days before the fruits ripen, being what is called three-quarters fit. They are then prepared for

the market by wrapping with dry banana trash, or otherwise with a regular plantain bark pad made expressly for the purpose. From the time the bunches are cut till they go on board the ship, they require very careful and gentle handling, which unfortunately they do not often receive, owing to the number of times that they have to be handled, packed and unpacked before they reach their final destination on board the steamer. The simplest bruise, that would be hardly noticeable at the time, would soon cause decay, and the fruit itself is of such delicate structure that rot once setting in spreads very rapidly to all the fruit in the immediate vicinity. After being cut in the fields the greatest watchfulness is necessary to prevent the labourers dumping the bunches down on each other. Hundreds of bunches are rejected at the wharves owing to this careless handling in the fields.

The packing of the fruit in carts, which should all be on springs, has also been reduced to a fine art. An expert packer will perform what would seem a miracle to an outsider, by being able to stow away some forty of these great big clumsy looking bundles into a space, hardly sufficient by appearances to hold twenty. On their arrival at the wharf after a journey of from 20 to 30 miles, they are again unpacked, the best fruit being selected by the purchasers, and are piled up at the wharf, awaiting the arrival of the steamer. On the latter coming in sight these fruit go through another course of handling and are packed on large whalers, holding as many as six hundred bunches, and taken out to sea, after reaching the fruit vessel they are again unpacked and passed up from hand to hand till they reach their final resting place on this side of the ocean in the hold of the steamer. Is it any wonder then after the long journey with all its accompanying joltings and bumpings and several courses of handlings both before and after its long journeys on land, that we read so often of whole ship-loads being dumped overboard on arrival at their destination, being perfectly unfit for food.

REPORT: BANANA EXPERIMENTS IN VERE.

By H. H. Cousins, M.A. (Oxon.)

The Vere planters are anxious for information as to Banana cultivation and Mr. G. Murray, as representing Caswell Hill and New Yarmouth, called upon me to assist with soil analyses and manurial experiments.

The soil analysis is appended with comparative data from St. Catherine. The Vere soil is heavier owing to the finer grade of particles. It will get lighter with cultivation and is well suited for Banana cultivation but requires drains and well-regulated irrigation Chemically the soil is somewhat disappointing. Carbonate of Lime is deficient, Potash and Phosphoric Acid both low. The available Potash is only $\frac{1}{10}$ of that in the St. Catherine soil. The Phosphoric Acid is also below the standard we have laid down for a soil not in need of phosphatic manures (0.010 o/o).

I visited these properties on February 7th and was greatly pleased with the agricultural management. I venture to say that the Vere sugar planters have set a high example to other cultivators in the way they have cultivated and arranged their irrigation and drainage. The

water is conducted along raised furrows while trenches have been provided sufficient to secure proper drainage. I was agreeably surprised to find no trace of water-logging or stagnation of soil. Some of the fruit then showing was only of 7 and 8-hand grade. This was undoubtedly the result of hurricane damage to the suckers. The later stems gave to the eye every promise of giving a high percentage of straight bunches.

Considering the small reserve of Potash in the soil, I thought it desirable to try the effect of Potash in various forms.

Mr. Murray prepared ashes from Logwood, Dogwood, and Cashaw for analysis. The Cashaw ashes at 5 per cent. Potash offer the greatest advantage. I have started experiments to test the wood ashes against commercial Sulphate of Potash.

With the living example of Egypt before us, we should strain every effort to secure and extend the irrigable area on the southern side of the Island. There are great possibilities for this district were all the available water made serviceable for irrigation.

SOIL ANALYSIS.

Reference Number —90.

Source details—Soil from Banana land under irrigation. Caswell Hill Estate. Vere.

Depth of Sample—9 inches.

Physical Analysis.

		Vere,	Average S. Catherine Banana Lands.
		Per Cent.	
	Stones ...	Nil	
	Gravel ...	0·56	1·60
	Sand ...	1·59	8·67
	Fine Sand ...	11·35	40·44
	Silt ...	71·05	43·77
Agricultural Clay. (8·21)	Fine Silt ...	3·02	1·19
	Clay ...	5·19	0·62
	Moisture ...	7·24	3·66
	Total ...	100·00	100.00
		Per Cent.	
	Retentive Power for water ...	65·0	50·0

Chemical Analysis.

Soil passed through 3 m.m. Sieve dried at 100 C.)

	Vere	Average S. Catherine Banana Lands
Insoluble Matter ...	64·85	71·06
Soluble in Hydrochloric Acid	35·15	28·94
Potash ...	0·1107	0·445
Lime ...	0·6279	1·573
Phosphoric Acid...	0·0579	0·194
Carbonic Acid as Carbonate of Lime	0·116	0·438
Combined Water and organic matter	10·32	7·090
Humus (soluble in Ammonia)	2·11	1·604
Nitrogen ...	0·1245	0·152
Hygroscopic Moisture	7·81	3·800

Fertility Analysis.

	Vere	Average S. Catherine Banana Lands
Available Potash ...	0·0011	0·0110
Available Phosphoric Acid	0·0051	0·0720

Wood ashes from Vere.

	Cashaw.	Dogwood.	Logwood.
Moisture %	0.82	Nil.	0.22
Potash %	4.96	3.35	4.05
Phosphoric Acid %	1.03	0.51	2.20
Lime %	47.78	45.92	48.10

(10 cwt. Cashaw ashes = 1 cwt. Sulphate of Potash costing 12/9.

Experiments recommended to:—

George Murray, Esq.,—"Caswell Hill"

Plot A—1 acre	...	1 cwt. Sulphate of Potash.
Plot B—$\frac{1}{2}$ acre	...	1 cwt. Sulphate of Potash.
Plot C—1 acre	...	10 cwt. Cashaw Ashes
or $\frac{1}{2}$ acre	...	5 cwt. do.
Plot D—No Manure.		

SEA ISLAND COTTON IN THE UNITED STATES AND IN THE WEST INDIES.*

By Sir Daniel Morris, K.C.M.G., M.A., D.Sc., and Mr. J. R. Bovell, F.L.S., F.C.S.

Summary.

In the preceding pages a considerable amount of information on a large number of topics is furnished for the guidance of cotton growers in these colonies. An appreciable portion of this information has been obtained at first hand in the Sea Island cotton districts of the United States, and by such means cotton growers in the West Indies are placed in a favourable position for carrying on the industry, while at the same time they are enabled to overcome many, if not most, of the difficulties inseparably associated with starting a new industry.

Great interest is being taken in cotton growing in many parts of the world. The high prices now ruling for all kinds of cotton should stimulate production, and eventually large supplies of cotton will be placed on the British and Continental markets. A fall in prices will naturally follow, and in the long run only the countries, where the conditions of soil, climate and labour are most favourable, will reap the best results.

In the case of Sea Island cotton (the kind recommended for cultivation in the West Indies) the competition of other countries will, probably, be not severely felt This cotton, recognized as the finest in the world, is a native in these islands. It cannot be grown beyond the influence of sea-air, as it has been shown in Georgia and elsewhere that the quality greatly deteriorates. It will therefore be difficult, if not impossible, to increase the production of this cotton to such an extent as greatly to depreciate its value at any time. In addition to this the tendency everywhere is to use the better sorts of cotton in order to produce finer fabrics, also articles where a strong fabric is required for goods combining lightness and strength, such as sails for yachts, mail bags, lining for bicycle tyres, etc.

* From "West Indian Bulletin," Vol. IV., No. 4, 1904, page 349.

Sea Island (that is long-staple) cotton is now selling at 12d. to 15d. per lb., while Upland (short-staple) cotton is selling at 6d. to 8d. per lb. It is generally acknowledged that where good Sea Island cotton can be grown, it is useless to devote attention to Upland cotton. This specially applies in the case of the British West Indies, as the areas available here for cotton growing are relatively small as compared with other countries, and it would be futile to attempt to compete in the class of cotton that could be grown over extensive areas, aggregating millions of acres, in Brazil, Peru, the Argentine, West Africa, Egypt and India.

With the view of meeting, as far as possible, the requirements of these colonies, the writers of this report have purposely confined the information contained in it to the treatment of Sea Island cotton. This cotton, it is true, requires more careful cultivation than ordinary cotton; the cotton worm has specially to be guarded against; the picking requires to be performed under close supervision; the seed is to be separated from the lint by means of *roller* gins, and not what are known as *saw* gins. Further, in the baling, Sea Island cotton requires less pressure than is the case with Upland cotton, and the packages are of a different shape. They are usually sent to market in long cylindrical bales resembling 'pockets' of hops.

Selection of Soil.

The typical cotton soil is described as 'a fine sandy loam' or 'a medium light soil of good average fertility.' It is undesirable to attempt to grow good Sea Island cotton on very poor lands, or those exposed to strong winds. 'Dry shallow soils' are to be guarded against, as also 'wet bottom lands.' Good drainage is essential. In light sandy soils the plants are usually small and the yield inferior; on slightly heavier and richer soils the yield is greater and the fibre stronger; while on heavy clay soils the plants become coarse and leafy, and the return in fibre is small in proportion to the size of the plants. Light and fairly deep soils may be rendered productive by the use of pen and other manures, and irrigation in localities where the rainfall is scanty would be of great advantage. Districts with an annual rainfall of more than 80 inches will probably be found unsuitable for cotton growing. Provided sufficient rain falls during the season of growth, so that the plants attain a fair size, they can afterwards bear comparatively dry and hot conditions.

Rotation.

It is undesirable that the same land should be replanted two years in succession in cotton. Such a course will probably lead to the exhaustion of the soil and to an increase in insect and other pests. The rotation adopted in the Sea Islands is as follows:—1st. year, cotton; 2nd. year, fallow; 3rd. year, cotton; 4th. year, leguminous crop. Something of the same kind might be followed in the West Indies. In any case, the continual cropping of land in cotton, without high cultivation and manuring, must result in crops inferior both in quantity and quality.

Preparation of Land.

Hints as to the preparation of land in bush, or lands formerly in canes, together with the probable cost in the different islands have already been published (pp. 225–41.) Before the seed is planted the

land should be thoroughly forked or ploughed and the heavy clods broken so as to form a fine mould. In well-drained and dry situations the land may remain flat, in others it may be arranged in ridges, 4 ft. or 5 ft. apart, and the seed planted on the top or side of the ridge, depending on the exposure. In cane lands already holed the seed may be planted on the banks around the holes. It would be of great advantage, in fields where the cotton plants are liable to be exposed to strong winds, to plant beforehand head rows of pigeon peas and guinea corn in order to afford protection during the early stages of growth. On sugar estates cotton might be planted to leeward of canes to be reaped after the cotton crop is gathered.

SELECTION OF SEED.

The use of good seed and its production by a regular system of selection are just as important factors in the production of good cotton as that of cultivation. It is recommended that only the best selected seed, obtained direct from the Sea Island cotton districts of South Carolina, be planted in the West Indies during 1904. Such seed may be obtained at cost price through the Imperial Department of Agriculture on application to the local officers in each Island.

DISTANCE APART.

The distance between the plants will depend on the soil and situation. In light soils the plants may be as close as 3 feet by 1½ feet, in slightly heavier and richer soils 5 feet by 20 inches, or 5 feet by 2½ feet. The seeds may be dibbled by hand or by means of a 'planter.' They should be thinned when about 4 inches to 6 inches high, and only *one* plant left in each hole. In light soils the seeds should be planted about 3 inches below the surface; in rather stiff soils 2 inches will be deep enough. The soil should, in every case, be pressed firmly over the seed.

SEASON FOR PLANTING.

The best time for planting will depend on the occurrence of the summer rains. In localities where the rains fall in June, July or August, cotton might be planted in either of these months. In others, the planting may be as late as the beginning of September; but should dry weather set in early in December, cotton planted in September would be liable to suffer. Early planting, when the circumstances admit of it, is regarded with favour as the plants become strong and vigorous before they are attacked by disease. On the other hand, if planted late, they may escape the attacks of the cotton worm, and the expense of treating them with Paris green and lime would be saved.

The season of 1903-04 was so exceptional everywhere on account of heavy rains and high winds, that it is impossible as yet to advise, with any degree of confidence, the exact period when Sea Island cotton should be planted in the West Indies. There is little doubt, however, that advantage should be taken of the early summer rains, whenever they fall, to start the cultivation, and probably it will be found that the planting season will extend in the different islands from the middle or end of June to the beginning of September of each year. It is very undesirable to plant cotton at any time outside these months; and during the present season, at all events, on account of the liability to disease, it would be advantageous not to carry over the cultivation by ratoons into the next season.

Cultivation.

During the season of growth the cotton plants require constant attention. The land should be kept free from weeds, the plants moulded up and close watch kept for the cotton worm and other enemies. During the months of September, October and November, or during any period when the cotton worm is expected, the fields should be inspected daily. On the first appearance of the worm Paris green and slacked lime, in the proportion of 1 to 6, should be immediately applied. A single day's delay in the treatment of the worm may entail considerable loss in crop It is advised that about 3 lbs. of Paris green and 18 lbs. of powdered lime should be kept ready at hand for every acre planted in cotton. The other enemies of cotton are discussed in the preceding pages. Paris green may be obtained in large quantity direct from the manufacturers at about 12 to 15c. per lb. In small quantity it may cost, locally from 20 to 30c. per lb. In applying Paris green and slacked lime one or more bags may be attached to a bar. When the plants are easily within reach, the bags need not be attached to a bar at all. but held in the hand and shaken above and to windward of the plants.

Picking Cotton.

A few essential points under this head may be mentioned :—(1) bags to hang from the shoulders should be provided to enable the pickers to have the free use of both hands; (2) at starting the pickers should be carefully shown how to pick cotton quickly without injury to the plants and free from the admixture of bits of leaves, trash, etc.; (3) each morning before they begin work, or after their return in the afternoon, the pickers (without further pay) should go over the seed-cotton gathered by them, before it is mixed in bulk, and clear it of all extraneous matter. By this means they will learn to be more careful in picking the cotton in the field, and so lessen expense to the planter in 'assorting' it before it is sent to the factory. The cost of picking Sea Island cotton should not exceed 1c. (½d.) per lb. of seed-cotton as brought in from the field. In some parts of the West Indies seed-cotton is picked at the rate of 0 to 40c. per 100 lb

Drying and Assorting Cotton.

Directions under this head are given on pp. 304-5. When seed-cotton has been affected by rain or disease, it should be 'whipped' before it is assorted and dried, otherwise it will be difficult to pass it successfully through the gins. (See pp. 304-5.)

Ginning and Baling Cotton.

As there are now more than a dozen ginneries in working order in the West Indies, no information is necessary under this head beyond that already given in pp. 305-9. The freight proposed to be charged on cotton shipped from all parts of the West Indies to the United Kingdom by the Royal Mail and other companies is at the rate of 65s. per ton weight.

Disposal of Cotton Seeds.

It is urged that no cotton seed be exported from these Islands. It should be retained for feeding stock to yield manure in order that its fertilising properties may be taken back to the land. Hints under this head are given on pp. 323—5. Where covenient the seeds may be

crushed in a mill or reduced to a fine meal. The cost of grinding cotton seed into a meal should not exceed 8c. (4d.) per 100 lb. Some planters are crushing cotton seed in an ordinary corn and cob crusher. By this means it is possible to crush the seed as required and so prevent its becoming mouldy Mouldy cotton seed is regarded as likely to be injurious to all kinds of animals. It should be remembered that cotton seed, either whole or ground into meal, is a highly concentrated food and it should be sparingly given to animals. It would be desirable to mix it largely with other food

YIELD AND COST OF PRODUCTION.

These in the case of the Sea Island districts, are discussed on pp. 313–4. It would appear that, in South Carolina, from actual returns of fourteen typical estates, the average yield was at the rate of 204 lbs of lint per acre, that the cost of cultivation and all expenses was at the rate of $35·40 per acre The returns for the lint and seed were $57·86 leaving a net profit of $22·47 per acre.

In the West Indies, if we assume that the return in the lint is at the same rate, viz 204 lbs. per acre, and the total cost of placing it in the Liverpool market 7d. per lb., for cotton fetching 12d. per lb., there would remain a net profit at the rate of £5 2s per acre This would allow for expenses of cultivation calculated at the rate of £3 per acre ½d. per lb. for picking 1½d. for ginning and baling and the balance for freight (65s. per ton weight), manure, commission, brokerage, etc.

NOTES ON COTTON IN JAMAICA.

Mr. J. Shore, Little River, writes :—

"Cotton seems to grow like a weed, and gives a larger return than generally stated. One acre, planted end September, 1903; supplied twice, 80 per cent. grew; cost to end March £5 6s. for everything. 1,200 lbs. seed cotton picked, picking still going on, with probable return of as much more. Bushes in full blossom again. Egyptian variety. Planted near sea, distant about 25 chains, and 100 feet elevation; in exposed situation and bushes much blown about by the frequent high winds and 'northers.'"

Mr. J. D. Ormsby, Lime Hall, writes :—

"I think I can afford some information *in re* cotton planting, which may be of service to intending growers. I was very unfortunate with the Egyptian seed you sent me some time ago, not more than one per cent. germinated, and on searching the holes in which I had planted them I found only the husks; insects had eaten all the kernels. Insects are the pests of my life, my place abounds in them. I have to soak all my seeds in a solution of Jeyes fluid before I plant them, so I thought I would try that with the cotton too I began planting them on Monday 4th inst., and continued until Friday 8th. On Sunday eve I put 2 lbs. of the cotton seed in two quarts of the solution—¼ pint of Jeyes to 4 gallons of water—and on Monday I began to plant. On Friday, 8th, those planted on 4th had germinated, and to-day they are about 1½ inches high, with four open leaves, and I do not think I shall lose 5 per cent. of the seeds. I planted two seeds in each hole, and in almost every case two plants are up I planted over two acres with the seed you sent me, 2ft. 6in to 3 ft. apart. I am sorry now that I

did not plant only one seed in each hole. I had recently dug 140 chains of trenches 18 x 18 in., and the loose earth was at the side of the trenches, clay land. I planted on all those ridges, and ¼ acre of same clay land thoroughly forked, ½ acre of gravelly land. I planted on hills dug like sweet potato hills, 2ft. 6in. apart, and the balance I planted in dry land. I had three lifts of the fork in each hole, each lift raising the earth and loosening it, giving a diameter of about 18 in. loose earth and two seeds planted in the centre of each. I covered all seeds about an in Later on I will let you have results. The seeds planted on Friday have germinated. Seeds should be soaked not less than 12 hours."

"THE KUMQUAT" (Citrus japonica).

By George Loutrel Lucas.

This member of the Citrus family, commonly called "Kumquat,' is a native of Japan, where it is known as "Kin-Kan" which means "Gold Orange;" "Kumquat" being Chinese for the same name. In Japan it is exclusively grown upon stocks of Citrus trifoliata, sometimes attaining a height of 12 feet. It produces abundantly a small and very handsome deep yellow fruit which is eaten entire, rind and all, in the fresh state or preserved. Crystallised or preserved the Kumquat makes a most delicious confection, and wherever known is very popular.

The Kumquat grows equally well budded upon wild lemon stock, and Citrus trifoliata stock, the latter being preferred by most growers.

This desirable fruit has not received the attention in Jamaica that it deserves, and with the exception of a few trees growing near "Bog Walk," which were imported from Florida a few years ago, no attempt has been made to foster an industry that would assist in adding wealth to the island. Kumquat trees grow well and produce an abundance of fruit with me [near Constant Spring], and there is no doubt in my mind that this can be made a profitable crop by those who care to take the trouble to properly cultivate the trees.

The usual distance for planting is 12 feet by 12 feet, even 10 feet apart would not be too close; and being cultivated exactly like an orange grove, i.e.,—the ground thoroughly worked and kept mellow and free from weeds and grass, adding a little commercial fertilizer twice a year to each tree, or sowing cow-peas between the trees every six months and lightly turning them under before the plants flower, will enrich the soil and stimulate the trees in producing heavy crops of fruit.

The fruit can either be preserved here in Jamaica, or it can be shipped to England where the large preserving factories would gladly purchase it in large quantities.

There are two varieties of this fruit, the oblong (Nagami) and the round (Marumi), the former being about 1½ inches long by one inch in diameter, deep orange-yellow rind, sweet and spicy, pulp tender and agreeably acid; the tree handsome with slender branches, without thorns, leaves small, narrow, oval, or almost lanceolate; fruits produced freely

The "Marumi" differs but slightly, except in size and shape of the fruit.

To Preserve Kumquats.

Clip fruit (all fruit should be clipped and never pulled) from the tree, remove buttons, wash in clear water and place in a receptacle containing cold water; let fruit come to a gentle boil then throw off water and add more cold water covering fruit thoroughly; allow to simmer gently for half an hour and then again pour off the water.

For the third time add sufficient cold water to cover fruit, adding three-quarters of a pound of white or granulated sugar to every pound of fruit. Allow them to cook gently until the Kumquats can be pierced with a straw and have become as nearly transparent as it is possible, taking care to not allow them to cook too rapidly, else they will crack and burst open, the object being to preserve them whole. When thoroughly done place in heated glass jars *immediately*, not allowing the preserves to cool, and seal tight AT ONCE. The result, if recipe is properly followed, will be a most delicious preserve.

THE JUNIPER CEDAR OF JAMAICA, II.

An article by Dr. M. T. Masters was noticed in the Bulletin* a short time ago on the Juniper Cedar of Jamaica. Dr. Masters pointed out that it is not, as had been supposed, identical with the Juniper of Bermuda, but was probably the same species as the "Red Cedar" of N. America

Prof. C. S. Sargent, Director of the Arnold Arboretum of Harvard University, has confirmed Dr. Masters'† opinion that our tree is quite distinct from the Bermuda tree, and he states that it is identical with the special Red Cedar that is a native of Florida.

Commercially this is important, for the Florida tree is the pencil cedar of commerce The trees of Florida and Jamaica will now be known as *Juniperus barbadensis*.

Plants are available for distribution at Hope Gardens.

Extract from Prof. C. S. Sargent's "Silva of North America."

Since the tenth volume of this work was published in 1896, I have had several opportunities to re-study in the field the Red Cedars of North America, and it now seems necessary to separate *Juniperus virginiana* as there described into three species:

First, the *Juniperus virginiana* of Linnæus, the Red Cedar of the north, with comparatively stout branchlets, erect branches which usually make a narrow, compact pyramidal head, or sometimes in old age become more horizontal and form an open round-topped crown, and fruit which ripens at the end of the first season. Second, the Red Cedar of the Florida peninsula with more slender pendulous branchlets and long often pendulous branches which spread into a broad open head and smaller fruit ripening at the end of the first season. Third, the Red Cedar of western America with rather stouter branchlets, fruit which does not ripen until the end of the second season, and lighter coloured usually reddish brown wood.

In Florida the Red Cedar, which is not distinguishable from *Juniperus barbadensis* of the West Indies, is a tree sometimes fifty feet in height, with a trunk occasionally two feet in diameter, covered

*Bulletin of the Botanical Department, Jamaica, VIII., 55; April, 1901.
†Silva of North America, XIV., 89; 1902.

with thin light red-brown bark which separates into long thin scales and small branches which are erect when the tree is crowded in the forest, but in open ground are ascending and spreading and form a broad flat-topped head often thirty or forty feet in diameter.

The secondary branches are long and slender, and are erect at the top of the tree and pendulous on the lower branches. The staminate trees are of open habit, with light-coloured yellow-green foliage, and the pistillate trees are of more compact habit with dark green foliage. The branchlets are slender, four-angled, pendulous, and at the end of four or five years, when the leaves disappear, are light reddish, brown or ashy gray. The leaves are opposite in pairs, closely impressed, narrow, acute or gradually narrowed above the middle and acuminate, and marked on the back by a conspicuous oblong gland. The flowers are dioecious and in Florida open early in March. The staminate flowers are oblong, elongated, and from an eighth to nearly a quarter of an inch in length, with rounded entire anther-scales which bear usually three pollen sacs. The scales of the pistillate flowers are gradually narrowed above the middle and acute at the apex, and become obliterated from the fruit. This is sub-globose, dark blue, and covered when ripe with a glaucous bloom, and is usually only about an eighth of an inch in diameter, with sweet resinous flesh and usually two seeds.

In the United States *Juniperus barbadensis* is distributed along the Atlantic coast from Southern Georgia to the shores of the Indian River, Florida, and on the Gulf coast from the Northern shores of Charlotte Harbour, Florida, to the valley of the Appalachicola, growing usually in inundated river-swamps and forming great thickets in forests of Taxodium, Red Maple, Gordonia, Loblolly Pine, Swamp Oaks, Palmetto, and Liquidambar; and in the West Indies it grows on the Bahamas, San Domingo, the mountains of Jamaica, and on Antigua.

The wood, which resembles that of the Red Cedar of the north in colour and fragrance, is straighter-grained and more easily worked, and for many years and until the supply begun to become exhausted it was exclusively used by the German manufacturers of pencils, who have established large factories for cutting this wood at Cedar Keys and other places on the Florida coast.

Juniperus barbadensis, with its long spreading branches and elongated gracefully drooping branchlets, is one of the most beautiful of all Junipers, and it has been largely used for the decoration of the squares and cemeteries of the cities and towns in the neighbourhood of the coast from Florida to western Louisiana.

THE STORY OF THE PAPAW.

By F. B. Kilmer.*

(Continued from Bulletin for August, 1903.)

The Milk of the Papaw.

Trees that give milk are plentiful in the tropics. The native name for the papaw is "lechoso" (a producer of milk). When an incision is made in the bark of any part of the tree or in the fruit rind, a limpid, milk-like fluid exudes very freely. It is slightly more dense than water, and in contact with the air quickly coagulates and closes the incision. This coagulation is a rather notable phenomenon.

For the fraction of a minute the liquid flows as though a milk bottle were uncorked, and one imagines that gallons will run without stopping, but suddenly it ceases On examination it is found that the milk is coagulated for a considerable distance within the glands. I am

*Reprinted from the "American Journal of Pharmacy."

quite firmly convinced that this action is due to the presence of a clotting enzyme. This assumption is made probable by the fact of the quite universal presence of pectin in plants, and further from the fact that I have proven the presence of calcium salts and pectic compounds in the latex of the papaw. This statement is further strengthened by my observation that the latex of the papaw will coagulate the juice (neutral or alkaline) of certain other plants The presence of rennin ferment in the latex of the papaw is noted elsewhere in this paper. Its behaviour is, in many respects, unlike that of the jelly-forming enzyme here noted, and, while further examination of fresh material is needed before making any fuller statement, I think I am safe in announcing that we may add the papaw latex to the list of plant juices in which the pectase ferment has been noted.

The odour of the fresh milk is pronounced, and not unlike that of the latex of the india-rubber tree, and on the whole, is a disagreeable one, suggestive of decayed meat. The taste is somewhat bitter, rather markedly astringent and acrid. When dried by artificial heat the ferment power is weakened or lost, if dried in the sun it retains its activity and about 75 per cent. of moisture is separated.

This milky emulsion seems to be secreted for the most part in fairly large vessels (readily observable by a pocket lens), which lie just under the epidermis in every part of the plant. In the ripened fruit it seems to permeate to all parts of the fleshy portion of the fruit (somewhat changed in character). The supply of milk in a vigorous tree is very abundant After making several prolonged incisions in a single fruit, I estimated that an entire tree must contain several hundred ounces, but no such amount can be obtained by any practical method.

The dried milk of the papaw is an article of commerce, and its character is dependent upon the method of preparation. The main source is the crude method of the natives. The usual proceeding is to make an incision just through the rind of the green fruit; the milk flows freely for a short time; this is caught in a dish, coagulation follows closely, and the milk oozes slowly through the incision for twenty-four hours or more. If numerous incisions are made in the fruit, it will, at the end of this time, become ½ an inch thick. The milk is most abundant after heavy rainfalls, from the first fruits of the tree, and naturally so from vigorous plants.

The latex, when allowed to dry on the fruit, becomes discoloured and dark. The lighter-coloured and best products are produced when the coagulated juice is removed as fast as it exudes, spread out thin and quickly dried.

No advantageous method of gathering the milk has come under my observation. Some of the difficulties of the present usages can be imagined by the recollection that in some cases the fruits are from 20 to 30 feet from the ground. The coagulation allows only a small yield, requiring constant climbing to make fresh incisions. The latex yields 25 per cent. of dried material (still containing 6 to 10 per cent. of moisture.) Under favourable conditions I extracted 100 grammes of latex from one fruit. One gatherer claimed an average yield of one pound of dried milk from each tree per year, though under somewhat adverse conditions it required fifty trees to yield one pound of dried milk.

OFFICE OF THE MILK AND ENZYME.

The office of this milk in the economy of the papaw is not easy to explain. Parkin (*Pharmaceutical Journal*, 1578, page 337) states :—"The most important function of such a latex is that of holding water in reserve." This seems hardly possible in respect to this plant because all tissues of the plant are filled with a watery fluid, so much so that they flow upon cutting, and it is hardly possible that the tree is dependent upon the milky juice for a supply of moisture. The native observers suggest that the milk has to do solely with the ripening of the fruit, and it is true that as the fruit ripens it is in all parts permeated with the milk, and as a consequence the starch compounds are changed to sugar; the proteids are peptonized and the flavour mellowed. But it would seem to be a prodigions waste of energy if this ripening action was the only action of the milk and its enzyme contents.[11]

We do know, however, that this latex is the carrier of enzymes, and that in plant life certain enzymes play an important part in incorporating material for the growth of the living substance or of preparing material brought to it, so that it may be capable of such incorporation. Again, they bring about decompositions which supply the energy needed for the maintenance of vital processes. In other words, these enzymes digest and prepare food for plant life and growth.

J. Reynolds Green has shown that in the process of nutrition in plants, when the constructive processes are active, an excess of material is elaborated and deposited in temporary reservoirs This material is utilized by a process of digestion brought about by the agents of enzymes or ferments which are formed to digest these deposited materials. From many plants we have been able to separate diastasic, proteolytic, glucosidal, emulsifying and other ferments.

The papaw is a plant of quick growth. It rapidly appropriates and converts decaying vegetation. Its best fertilizers have been found to be dead vegetable and animal matter, house waste, etc. This suggests that the presence of this abundance of enzymic power is necessary for the digestion and conversion of plant-food material, and that the material is prepared for incorporation in the living plant by the enzymes present in the latex.

The milky juice of the papaw can therefore be imagined as quite akin to the gastric or pancreatic juice of the animal organism. The ducts through which this latex flows are possibly digestive tracts; their contents, an emulsion of partially digested proteid and other material, under transformation preparatory to ultimate assimilation.

Corrosive Properties of the Latex.—The corrosive action of the latex has been recorded; all species have this property in some degree. Persons who handle the green fruit in the preparation of pickles are troubled with raw and bleeding fingers and are forced to abandon the work. The fresh latex will irritate the mucous membrane and its continuous use is in some instances very escharotic. This property seems more manifest in certain isolated plants of apparently the same

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(11) Assuming that there is at the lowest estimate, 100 ounces of latex in a tree, we would have twenty ounces of dried material capable of converting about 3,000 pounds of proteids.

species. This is true not only of the Carica Papaya, in universal cultivation by the natives, but also in other species the fresh juice will blister and cauterize almost instantly. A caustic property is not unusual in many tropical plants. In the milk of the papaw it is not due to acid constituents, as it is still present if the slight acidity is neutralized It can be removed by chloroform and ether, and is either removed or destroyed in some of the processes of separating the ferments (precipitation).

The corrosive constituent is not volatile and remains in the dried juice. An examination of many of the preparations sold in our market under the name of "papain," etc., shows that this corrosive property had not been altogether removed.

ANALYSIS OF PAPAW LATEX.[12]

This latex is an emulsion of fats and wax, containing also extractive matters, albumen and salts, as shown by the following:

CARICA LATEX—SUN-DRIED.

Moisture	6·06
Soluble Ash	2·64
Insoluble Ash	4·78
Matters soluble in water (including ash)	82·74
" " benzine	11·43
" " ether	9·77
" " chloroform	11·20
" " acetone	5·98
" " alcohol	7·16

ASH.

Total ash	7.42
Soluble ash	2.64
Insoluble ash	4.78
Calcium sulphate—insoluble ash	0.896
Calcium phosphate "	3.72
Silica "	0.164
Calcium sulphate—soluble ash	1·024
Potassium, sodium, lithium, chlorides and carbonates—soluble ash	1·616
Chlorine	0.22
Ferric oxide	trace

Alcoholic extract (7·16 per cent.) is coloured, astringent and has a somewhat acrid taste. The concentrated extract is dark brown, resembling well known solid extracts. Evaporated residue is only slightly soluble in ether and chloroform, but is partially so in a cold 5 per cent. solution of sodium hydrate. It is further dissolved upon heating. Alcohol added to this sodium hydrate mixture dissolves it completely Acid added to the aqueous or alcohol alkaline mixture gives a saponification indicating resins.

Some observers have reported a glucosidal body in the Carica latex. The usual tests for such substances, when applied to this extract, give negative results. In my hands this extract gave no indication of tannin, although this substance has been reported as present in the milk. The acrid resins of the papaw are more or less extracted

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(12) Owing to the length of this paper, the detailed methods of analysis have been omitted. In most cases the methods were those in common use.

by alcohol, but more completely by acetone. The alcoholic extract is acid to litmus.

In this alcoholic extract the presence of an indicator was observed. When the extract is somewhat concentrated, the colour becomes a beautiful pink which is destroyed by sodium hydrate, added to saturation and concentrating the solution to dryness. The colour is not restored by hydrochloric acid. (This colour substance needs further study.)

Ether extract (9·97 per cent.) is nearly colourless, yielding upon evaporation a residue resembling white beeswax. This residue is quite soluble in chloroform, but only partially soluble in benzine or alcohol (Soluble in hot alcohol.) The aqueous washings of this extract give an acid reaction with litmus and a precipitate with lead acetate.

Chloroform extract (11·20 per cent.) is colourless and slightly turbid. The residue upon evaporation, is wax-like, and hard (much resembling the residue from the ether extract.) This residue is partially soluble in ether, and almost insoluble in alcohol and benzine. The aqueous washings from this extract give an acid reaction to litmus.

Acetone extract (5·98 per cent.) is of a yellowish colour. The evaporation residue has a pungent, slightly aromatic odour and a dark brown colour resembling the extract of plants. The residue is almost wholly soluble in alcohol, chloroform and amylic alcohol; but slightly soluble in ether, and insoluble in benzine.[13]

As the substances removed from the latex by volatile solvents were in the nature of material foreign to the enzyme, no systematic examination was made. These solvents do not seem to remove any proteid compounds save in the case of benzine, which extract gave a faint proteid reaction.

As a result of a hasty examination of these extractions we may assume that they contain colouring matter; "vegetable extractive matter;" hard and soft waxes; hard and soft resins; a volatile resin; a substance of the nature of fatty acids; pectose compounds.[14]

WATER SOLUBLE CONTENTS.

The dried latex extracted by repeated washings with water gives 82·74 per cent. of matter soluble to a clear greenish-yellow solution. The watery extract is of acid reaction and responds to the usual tests for the presence of proteids, such as Millon's reagent; the xanthoproteic and bitter tests, etc; precipitates are formed by alcoholic tannin, picric acid, platinum chloride, metaphosphoric acid, lead acetate, Mayer's reagent, mercury bichloride, potassium ferrocyanid and acetic acid. The presence of several forms of proteid substances is also shown by the following:

The filtered solution (noted above) is rendered turbid by heating to the boiling point. Upon continued boiling a very fine precipitate is

(13) The alcoholic and acetone extracts give slight indications of the presence of nitrogenous matter by the soda-lime process.

(14) Malic acid has been noted as being present in the latex of the papaw. The acid principles of these extracts of the milk when subjected to the usual tests for malic acid, gave but slight indications of its presence.

The aqueous solution of the latex was examined at length and judging by the reactions noted in the text-books, and compared with malic acid itself, the conclusion was reached that no malic acid or malates were present.

separated, though this is not abundant. Filtering and further boiling produces no further precipitation, but the addition of nitric acid drop by drop gives a heavy flocculent precipitate. The clear aqueous extraction noted above, slightly acidulated with hydrochloric acid and heated, shows a slight turbidity just before reaching the boiling point. Cooling and the further addition of the acid produces at once a heavy flocculent precipitate, which dissolves upon heating and reappears upon cooling.

A solution of sodium carbonate (0·5 per cent.) added to the clear aqueous extract of the dried latex produces an immediate turbidity which, upon heating, separates into a small amount of fine precipitate. From these last results it will be seen that the soluble albumins of the latex of the papaw are only partially coagulated by heat.

When concentrated hydrochloric acid is cautiously added to the clear watery extract of the latex, there is formed a heavy curdy precipicate, soluble in an excess of the acid. In a clear aqueous solution of the latex, concentrated nitric acid producing a heavy white precipitate, also soluble in an excess of the acid (proteid reaction). This precipitate turns yellow and dissolves upon heating (albumose,) but upon cooling is again precipitated. Upon adding an excess of acid, it is completely dissolved and not re-precipitated when cooled (globulin).

The presence of soluble globulin in an aqueous solution is further shown in that the precipitate produced by boiling is not soluble in hydrochloric acid (0·2 per cent).

The residue left upon the extraction of the dried milk with water is partially soluble in a weak solution of common salt, and the resulting solution gives a precipitate with nitric acid (globulin).

The watery solution noted above, when rendered slightly acid (acetic) and boiled, is made turbid, forming small amount of flocculent precipitate (globulin and albumin).

The clear watery extract of the papaw latex, when saturated with ammonia sulphate, gives an abundant white precipitate with strong proteid reaction (the precipitate carrying the greater portion of the ferment). The precipitate just noted, freed from the ammonium sulphate, dissolved in water, made acid with acetic acid, and then saturated with common salt gives a white flocculent precipitate (primary albumose). After saturation with ammonium sulphate, the filtrate gives a precipitate, deutero-albumose, and the supernatant liquid, under the biuret test, shows the presence of peptones.[15] If precipitated by soda-magnesium sulphate, the filtrate likewise exhibits a strong peptone reaction.[16]

ANALYSIS OF PAPAW PROTEIDS.

It cannot be said that any of the enzymes have been completely isolated. The most that can be urged is that the enzymes are either proteid in character, or are associated with proteid bodies In all, or

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(15) By the digestion of a solution of this peptone with the separated ferment or with trypsin, leucin and tyrosin appear (indicating hemipeptone).

(16) The classification of the albumoses and peptones is the subject of controversy. The classification here followed is that in most common use. Under another view we would have in this substance a mixture of globulin, proto and deutero albumose with, possibly, two or more forms of peptone.

nearly all, attempts to separate the enzyme from the accompanying protein, the result has been a destruction of enzymic power. Again, when in our manipulation of the enzymes we alter or destroy the character of the proteids which are associated with them, we alter or destroy the character of the enzyme. While it cannot be said that the enzyme and the proteid are identical, we must admit that the enzyme and proteid are most closely associated

We have abundant authority to show that diastase is associated with leucosin; rennin is associated with hetero-proteose; bromelin appears in close relation to two forms of proteids, and so on through the list a close association of the enzyme with a proteid body can be shown. But it cannot be said that the proteid is actually the enzyme. So far as our present knowledge goes, an analysis of the proteid must stand for an analysis of the enzyme.

From the examination of the water-soluble contents of the latex of the papaw, we may reach the conclusion that the enzyme is associated with one or more of the soluble proteids. An analysis of these proteids bodies was therefore made, as follows:

For the purpose of analysis, a portion of the air-dried latex was extracted with alcohol, benzine and ether, to remove waxes, resins, etc., the residue consisting of the proteid matters and ash. This preparation is marked I. in the accompanying table.

A second preperation was made by extraction of the milk, as above, the product dissolved in water and the proteids precipitated by sodium chloride, and the precipitate partly freed from excess of salts, by dialysis.

This process was repeated with a view of obtaining an approximately pure preparation, and one representative of the enzyme of the latex. This preparation is marked II in the accompanying table.

Papaw Proteids.

	I. Per Cent.	II. Per Cent.
Air-dry		
Carbon ..	39·96	42·81
Hydrogen ..	6·57	6·77
Nitrogen ..	11 26	10·08
Ash, or mineral matter .	9·88	6·51
Moisture (loss at 100—105°C.) ..	10·83	7·90
Moisture-free.		
Carbon ..	44·81	46·84
Hydrogen ..	6·00	6·39
Nitrogen ..	12 62	10·95
Ash ..	11·07	7·06
Moisture-free, ash-free.		
Carbon ..	50·38	50·01
Hydrogen ..	6.74	6·87
Nitrogen ..	14·19	11·78
Oxygen ..	28·69	31·34
	100·00	100·00

The large proportion of mineral ash in the purest preparation—II—is notable and seems to indicate that the proteid constituents and the ash are most closely associated. Otherwise, we may observe that the carbon stands in about the same proportion as in other vegetable pro-

teids. We have, however, a much smaller amount of nitrogen than is present in most proteids; but this low content of nitrogen is quite in accord with the constitution of some of the enzymes which have been examined. This is shown by the following comparison:

			Nitrogen. Per Cent.
Bromelin (Chittenden)	..	..	10·46
Trypsin (Kuhne)	..	..	13·41
Papaw (Kilmer)	..	..	11·78
Peptone (Henninger)	..	..	16·38

The ferments of Papaw.

The latex of the papaw is notable from the fact that it contains several soluble enzymes or ferments, or else (if such a thing is possible) a ferment body with a fourfold power. The ferments so far noted as contained in the latex are:

(1) A proteolytic ferment which decomposes proteids.
(2) A coagulating (rennet-like) ferment which acts upon the casein of milk.
(3) An amylolytic ferment having the power to attack starch, etc.
(4) A clotting ferment similar to pectase.
(5) A ferment possessing feeble powers of action upon fats.

The digestive action of the latex at the instant of its extraction from the green fruit is very marked. Placed in contact with such a substance as blood fibrin in a little water, the fibrin will be disintregrated before your eyes, mixed with milk and warmed, the milk is instantly coagulated. Boiled starch paste is thinned, and the blue colour produced upon starch by iodine is changed to a purple in a few minutes. Poured over lumps of beef and placed in a warm place, the meat is softened, its fibres disintegrated, finally becoming a partially transparent jelly. The action upon cooked egg albumen is not so marked.

The latex when dried retains these powers in a somewhat lesser degree. I am of the opinion that the ferments exist in the latex, and possibly in the cellular structure, as a zymogen (carizymogen). This presumption is verified from the fact that after the extraction of the latex or pulp with water (preferably slightly acid or alkaline), a second maceration will bring a further yield of enzyme. I have repeated such a process ten times successively, in each instance bringing a further supply (small in amount) of the ferment into solution. If a considerable bulk of water (neutral, acid or alkaline) be added to the latex, and the resulting liquid be filtered and the residue on the filter paper washed with water, the greater portion of the ferment will be found in the filtrate.

(To be continued.)

BOARD OF AGRICULTURE.

A Meeting of the Board of Agriculture was held at Head Quarter House, on Tuesday, 16th February, at 11.15 a.m ; present—His Grace the Archbishop (Acting Chairman), presiding, the Director of Public Gardens, the Island Chemist, Hon. J. V. Calder, and Messrs C. A. T. Fursdon and J. Barclay (Secretary).

The Minutes of the previous Meeting were read and confirmed An apology for absence was received from Mr. C. E. de Mercado,

Mr. C A. T. Fursdon asked the meeting what his position on the Board was, saying that he sat as a representative of the Agricultural Society and they had just elected a new Board of Management The Meeting thought that as Mr. Fursdon represented the Agricultural Society, and not merely the Board, and had also been elected on the new Board of Management of the Agricultural Society, he remained a member of the Board of Agriculture

The Hon. H. Cork wrote to the Acting Chairman as follows :—"Will you kindly inform me whether I am still a member of the Board of Agriculture." The Acting Chairman said he was not clear as to what ought to be decided in this case, and the matter had better remain to get a ruling from the Chairman on his return.

As a matter arising out of the minutes, the Director of Public Gardens submitted a memorandum on the Bottling of Fruit, with list of prices and other information regarding bottling appliances. It was agreed to get a 35/ set of these to carry through some experiments, and the Chemist agreed to bottle and sterilize fruit if the Director of Public Gardens would provide it. This arrangement was agreed to.

The Secretary read the comments of the various members of the Board on the Sugar Experiment Scheme prepared by Mr. Cousins which had been circulated. Mr. Cousins read a memorandum he had prepared replying to the various objections raised. Mr. Calder said that he had not heard anything in what Mr. Cousins had said which would make him alter his opinion. He sympathised with some of the objections raised by Mr. Fawcett and he rather favoured Mr. Shore's scheme that we should have a Sugar Experiment Station where everything could be carried out on a small but model scale, which he thought would yield more useful results than experiments in the Laboratory. He thought that what they wanted most was an Agricultural College where they could include a Sugar Experiment Station and where they could breed horses and carry on dairying—in fact a training school for all the branches of agriculture. There would be no difficulty in having all the branches of sugar worked there too. The Acting Chairman suggested that they should adjourn this matter until the return of Mr. Olivier, the Chairman, and he proposed the following Minute :—

The Meeting felt that in the divided state of opinion among the Members of the Board as regards the Sugar Experiment Scheme, it could not usefully proceed further with the matter until the return of the Chairman, who was also the Colonial Secretary ; who had already given much consideration to the subject, and after reading all the documents he had not yet seen, would be in a position to advise the Gov-

ernment. The Secretary is accordingly instructed to refer all the papers to the Chairman on his return to the Island.

The Minute was unanimously agreed to.

Mr. Calder reported that as regards the Dairying Farm and Agricultural School they had offers of land, and the Committee would be able to visit these before the next Meeting and report on them.

The Secretary read the Report of the Committee on Cotton, as follows:—

A Meeting of the Committee appointed to consider the applications for £5 grants for an experimental acre of cotton, consisting of Hon. W. Fawcett, Mr. H. H. Cousins and the Secretary, John Barclay, met at Hope Gardens on Wednesday 27th inst. at 9.15 a.m.

The Meeting considered 34 applications and after rejecting those which were from good banana districts, chose the following ten, as representing the most suitable districts in soils and climatic conditions:

1. Miss Marvin,	Shortwood,	St. Andrew.
2. J J Robinson,	Stony Hill,	"
3. Arthur J. Webb,	Llandovery,	St Ann.
4. Rev. C. T. Ricard,	Pedro Plains,	St. Elizabeth.
5. A. C. L, Martin,	Alligator Pond,	Manchester.
6. Rev. E. A. Arnett,	for lower Trelawny	Trelawny.
7. C. R. Taylor, Secretary St. John's Branch Society,	Guanaboa Vale,	St. Catherine.
8. Thos. H. N. Cripps,	Dallas Castle,	St. Andrew.
9. C. H L Nicholson,	May Pen,	Clarendon.
10. Roland E. Gillespy,	Falmouth	Trelawny.

The Secretary read a Minute from Mr. Fursdon reporting that he had entered into arrangements with some Syrians, one of whom had long experience in all the branches of Cotton cultivation in Egypt, whereby they could grow cotton as an experiment on 40 to 50 acres of land in front of his house at "Two Mile Wood," Hartlands, on very reasonable terms and he had given him an option to purchase a block of 480 acres of land within the next 12 months.

The Board expressed satisfaction that these Syrians had been so encouraged and agreed that everything should be done with a view to facilitate the experiment.

The Secretary submitted applications for the use of the Steam Gin at Spanish Town, from the Hon T. H. Sharp, A. J. Webb, H. T. Ronaldson, and Mr. Fursdon on behalf of the Syrians.

It was agreed to assign the sum of not more than £20 for free grants of Cotton seed and the Secretary was directed to insert the following advertisement under Government notices, viz:—

The Board of Agriculture has decided to spend up to £20 from the grant made by the British Cotton Growing Association in the purchase of Sea Island Cotton Seed. The Board is prepared to consider applications for free grants of Cotton seed on the condition that full reports are made to the Director of Public Gardens, to whom applications are to be made.

A letter from the Colonial Secretary's Office in the matter of the Cattle Dock at the Railway, and a letter from Mr. Fursdon *re* same

were at the request of the latter, held over until the return of the Chairman.

The following Minutes were submitted by the Chemist:—

(a) *re* Terms of Appointment of the Assistant Chemist, whose engagement expired on the 22nd instant. It was agreed to recommend his re-appointment.

(b) *re* Instruction in Veterinary Science for Laboratory Students.

(c) *re* Teacher in Agricultural Book-keeping for Laboratory Students.

(d) Report of Fermentation Chemist. It was agreed to recommend to the Government that the proposals should be carried through.

The Director of Public Gardens handed in a Minute from Mr. Cousins on the water Supply for the Experiment Station at Hope, which had been sent to him and his reply. It was agreed to refer the matter to the Chairman on his return.

The Director of Public Gardens submitted the following:—

(a) Report on Hope Experiment Station from the 9th January to the 13th February 1904

(b) Report from Mr. Cradwick on his arrangements for instruction work up to the 13th April; these were directed to be circulated.

The Secretary submitted an account of his outlays on behalf of the Board, including the salary of the typist from June 16th to 31st December, and this was authorised to be paid.

The Meeting then adjourned.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday 15th March 1904, at 11.15 a.m., present, the Hon. Sydney Olivier in the Chair, Hon. W. Fawcett, His Grace the Archbishop, Messrs. H. H. Cousins, C. A. T. Fursdon, C. E. deMercado and John Barclay, the Secretary.

Dairy Farm and Agricultural School—With regard to the Dairy Farm and Agricultural School, the Chairman said that he would make arrangements with the Committee as early as possible to visit the places offered.

Cotton.—The Director of Public Gardens said that he had ordered 2,640 lbs. of Cotton seed and taking into account the orders they had in hand they would require 335 lbs. more. It was decided to give free grants of Cotton seed sufficient to plant one acre, to approved applicants and the Director of Public Gardens was authorised to order 1,000 lbs. more of Sea Island Cotton seed.

Applications for the use of the Cotton Gin were made by the Hons. T. H. Sharp, H. T. Ronaldson, and Messrs. C. A. T. Fursdon, and P. H. Greg. The Chairman moved that the Gin be placed with Mr. Fursdon at Hartlands, the Archbishop seconded and this was agreed to, Mr. Fursdon to gin Cotton from the experimental acres and any others offered to a reasonable extent at the standard rate of 1½d. per lb.

The Chairman stated that he was writing to the British Cotton Growing Association asking for two hand gins which could gin 200 lbs. a day.

The Director of Public Gardens submitted two reports each from Mr. W. Cradwick and Mr. W. J. Thompson and a report of Hope Experiment Station, all of which were directed to be circulated.

The Director of Public Gardens made application for an increase of £75 to his Vote for forwarding seeds and plants from Hope by coastal steamer, so that the freight could be paid for those receiving plants. It was decided that this should not be done. As regards the excess of £25 on this year accounts it was agreed to pass the amount.

The Chemist submitted the following papers:—

(a) Reports of Banana Experiments in Vere. This was directed to be published in the "Bulletin."

(b) Application for admission as an Agricultural Student by Thomas Dixon, Highgate. It was agreed to admit him on probation for a term of one year.

(c) Report on Manurial Experiments on Sugar Cane. This was directed to be forwarded for publication in the Agricultural Journal.

(d) Letter from Mr. Van Diepen, formerly Laboratory Student, reporting his progress in Costa Rica.

(e) Memo on Appointment of Superintendent of Sugar Experiments.

With regard to the re-appointment of the Assistant Chemist it was resolved to recommend his appointment on the same terms as before and that he should not be placed upon the fixed establishment.

Prison Farm.—The Director of Public Gardens submitted recommendations to purchase a Rice Huller for hulling the rice at the Farm, which amounted to about 34 flour barrels full. It was thought better to ascertain whether a purchaser could be found for the unhulled rice rather than get a Huller. It was also suggested that it might be disposed of locally for poultry food and other purposes. It was resolved to ask the Inspector General for a note of the cost of cultivation of the crop, excluding the capital expenses.

An offer from the United Fruit Co. to enter into a contract for the bananas grown at the Prison Farm was submitted. It was agreed to request the Inspector General to enter into a contract for a term of years and to recommend that the short bunches be sent to the Lunatic Asylum for the use of the inmates there.

The Chairman stated that as regards the supervising of the agricultural work at the Prison Farm, the Inspector General was of opinion that Mr. Geer the Chief Warder could now carry on the work efficiently and it was agreed to give Mr. Palache notice that his services would not be required from the end of the financial year. It was, however agreed to ask him if he would still be willing to advise the Board regarding the work at the Farm when required, at a certain fee.

In reply to a question whether the Farm was paying, the Chairman stated that it showed a profit of about £250 for the first 11 months of the current financial year. not counting crops in the ground. This was considered very satisfactory.

As regards the Fermentation Chemist's salary and travelling expenses, the Chairman stated that this had been provided for in the general estimates, but should be re-imbursed from the Imperial Grant

in aid of the Sugar Industry. It was recommended that if this sum was to be re-imbursed an equivalent amount should be utilised to give additional agricultural instruction.

Mr deMercado asked if there was no possible way for the Imperial Grant in aid of the Sugar Industry to be used in the same way as was done in Barbados to help the Sugar planters to tide over their difficulties. The Chairman said that the matter had been before the Governor in Privy Council several times and they had always decided against any proposal to distribute the grant by direct gifts to planters. The Chairman said that he thought it better that they should work on more permanent lines to help the Sugar Industry; he was disposed to favour the scheme submitted by the Island Chemist.

It would be well to bear in mind that the Imperial Grant of £10,000 could not now be used for the direct financial assistance of the Sugar estates and that the Government would not be prepared to operate a Sugar estate involving risks of loss.

The scheme submitted by the Island Chemist set forth in detail a proposal to extend local experiments on estates throughout the Island, on cane varieties, manuring and in rum manufacture with a central laboratory station at Hope. To secure efficient control over the local experiments and the cane varieties grown at the Hope Experiment Station a special Superintendent of experiments would be needed. The laboratory should be equipped for the analysis of sugars, juices, rums and estate materials from any sugar estate in the Island free of cost. A special sugar and rum laboratory was estimated for and also a small experimental distillery where crucial tests of rum manufacture could be carried out on a small practical scale with estate's materials specially brought in puncheons for the purpose.

Mr. Fawcett said that with reference to his minute in reply to the Chemist's scheme he wished his objections to the sugar distillery being at the Laboratory at Hope to be put on record. He would also protest against any proposal to place the Superintendent of Sugar Experiments in charge of the Cane Cultivation at Hope.

The Board, after full discussion, approved the scheme and decided to recommend to the Governor in Privy Council to give effect to it as soon as possible.

The extension of the Laboratory was approved and it was decided to recommend the appointment of a Superintendent of Sugar Experiments.

Mr. T. H. Sharp, Jun., Bachelor of Agricultural Science, of the University of Toronto was nominated for this office to be appointed for one year at salary of £150 with £100 reimbursement for travelling expenses.

The meeting adjourned.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. MAY, 1904. Part 5.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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KINGSTON, JAMAICA:
HOPE GARDENS.

1904.

JAMAICA.

BULLETIN

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CITRUS FRUIT CULTURE. II.*

By J. W. MILLS, with notes by PROF. E. W. HILGARD.

NOTES ON DISEASES OF THE ORANGE.

Three diseases of the orange tree are widely known in California. First in importance come two kinds of "gummosis," or "gum disease," that which attacks roots and trunks just above the surface of the ground, and second, that which is called "scaly bark" gum disease. The former has existed in Southern California since 1875. It makes its appearance where the ground has been allowed to remain wet close to the trees for long periods. E. W Holmes, of Riverside, says that he has seen fifteen per cent. of a seedling orange orchard become affected after heavy applications of nitrogenous manures followed by irrigation close to the trees during hot weather. All the affected parts should be cut out so as to remove every trace of diseased tissue In some cases this requires repeated cuttings and the use of an antiseptic wash.

The "scaly bark" gum disease is the most prevalent form in southern California. It attacks the trunk of the tree, and also some of the branches. If not checked at once, it will kill the tree. The new bark is unhealthy, and the disease soon penetrates to the centre of the limb or the trunk of the tree.

Antiseptic Washes for Gummosis.—The treatment for both forms of gum disease is the same. Use one part of crude carbolic acid to four parts of water. The Florida Experiment Station uses a wash of lime, crude carbolic acid, and salt. Slack one peck of lime in two gallons of water, and add, of crude carbolic acid four ounces, and of salt three pounds. If too thick, add a little more water.

In cases of the root form of gummosis, the soil should not be thrown back upon the roots after cutting out the diseased tissue, until the

*University of California, Agricultural Experiment Station, Bulletin No. 138. Continued from Bulletin of June & July 1903, page 168.

wounds begin to heal. It is necessary, however, to shade the roots from the sun. The diseased wood should be burned. Removal of the entire tree is often wiser than trying to cure the disease.

Value of Sour-Orange and Pomelo Stocks. - The "scaly bark" form of gum disease has not been observed in California on the Florida sour orange stocks. Such trees, budded to navel oranges two feet or more from the ground, are growing near the substation. Some of them have diseased trunks and branches, but in no case has the disease been found extending down to the sour-stock. Evidently there would be no advantage in using this resistant stock in low-budded nursery trees, but sour-stocks might be planted in the orchard and allowed to form the main branches of the future tree. Then should the "scaly bark" make its appearance, a few branches might be destroyed, but the trunk would remain sound Since the sour-stock has not given universal satisfaction in Southern California, the pomelo, which seems but little less resistant to "scaly bark" than is the sour-orange, and is a more universally vigorous grower, may be used. The sweet-orange, stock is the poorest of the three.

The "Die-Back" Trouble.—The third serious trouble is exanthema or "die-back." This name is given to a weakness affecting orange, lemon, and other orchard trees. There are several especially bad cases in the San Gabriel Valley, where solid blocks of citrus trees are now utterly worthless. Trees seven years old and in a frostless location have not attained a height of over four feet, in some instances, and bear little or no fruit, while adjoining trees of the same age and seemingly under similar conditions are of large size and bear heavy crops.

Orange trees affected with "die back" make an apparently healthy growth in the spring and early summer, but the young shoots soon turn yellow, the leaves drop off and the twigs die back to the older wood from which a brown granular substance exudes. In a season or two, this older wood also dies. Adventitious buds keep developing at the axils of the leaves, until at the end of the season there are small knots, where there should be healthy lateral branches. Experiments with Bordeaux mixture and carbonate of copper have been made in a badly affected grove near Pomona. The work so far has shown no appreciable results, but it has not yet been carried through one season.

[In almost all cases of "die-back," examination has shown some fault in the subsoil, which puts the roots under stress. Such fault may be an underlying hardpan or impervious clay, pure and simple; or it may be excessive wetness or dryness of the substrata surrounding the deeper roots; or the rise of bottom water from below, as in cases of over-irrigation The true "die-back" is not properly a disease, but simply the manifestation of the distress felt by the root-system underground. The first thing needful is to dig down and examine the roots, and then to relieve whatever fault may be found, if possible; which may not always be the case. Sometimes an appearance similar to the "die back" is caused by the roots encountering a marly stratum, which is apt to stunt the growth of the tree, causing it to put out a multitude of small, thin branches, and sometimes causing the tips to die off. For this form of the trouble there is no permanent remedy; the trees

should never have been planted in such ground, any more than in such as has shallow lying hardpan or clay. (E. W. H.)]

["*Mottled Leaf.*"—Closely related in its causes to the "die-back," and sometimes accompanying it, is the "mottled leaf" trouble. It may be properly called "partial chlorosis" of the leaves, and on the basis of that designation it has been attempted to treat it like the corresponding human ailment, with iron tonics and fertilizers. But in every case that I have closely examined, and in most of those reported to me by others who have made such examinations at my suggestion, the cause was not lack of nourishment that could be remedied by such means, but simply an improper condition of the root system, especially of the deeper roots. When a thriftily growing tree suddenly stops and begins to show mottled leaves, it is clearly not because of lack of nourishment in the soil, but because some of the physical requirements of the tree's well-being have ceased to be satisfied. In such case fertilization can afford but temporary relief, if any.

The commonest cause of mottled leaf is a layer of dry gravel or sand reached by the tap-roots, throwing them out of healthy action. Of course the same effect may be expected from the exhaustion of the usual supply of moisture in the substrata, which has not been made up for by the comparatively scanty irrigation permitted by the diminished water-supply during the past three years. The cause of the present great prevalence of mottled or yellow leaf in the citrus orchards is probably a parallel to the wholesale dying-out of vineyards in the Santa Clara Valley, regarding which a special bulletin (No. 134) was issued by this Station some months ago.

Quite probably, however, other unfavourable conditions affecting the roots, such as alkali, marl, or a hard-pan layer, may in many cases produce this effect. In any case, the cause should be sought for at the roots before deciding upon possible remedies (E. W. H.)]

Difficulty of Replacing Trees.—It is difficult to install new trees in an orchard when the surrounding trees are large. In fact it is necessary to dig very large holes and fill them with rich earth. Such trees should be given extra irrigation and additional fertilizers, besides what is regularly given to the older trees. This should not be applied merely to the space around the newly-set trees, but also to the adjoining older trees, as it is needful to furnish enough food and water for all the roots that fill the surrounding soil.

All orchardists find trouble in filling gaps where trees have died or become diseased, but the difficulties are more marked in the case of citrus fruits than with the deeper rooting deciduous species. A selection of especially healthy specimens from the nursery will help. Then, as noted, the best of culture and all the fertilizers that can be assimilated are needed. Lastly, the judicious root-pruning of large adjacent trees may assist those newly planted.

California Orange Standards.

Citrus-fruit culture includes much that can find no place in so brief a bulletin, but some of the more pressing and practical problems have been discussed. The interesting topic of wind breaks and hedges for protection against frost and storms has not been taken up, nor has the group of questions relating to the handling and marketing of crops.

But there is often an inquiry made respecting the official scale used by judges of citrus fruits at fairs and other competitions. A standard scale of points is that adopted by the Los Angeles Chamber of Commerce in 1894 and the following year by the Southern California Fruit Exchange. It seems well balanced, comprehensive and practical. At the present time it is the most widely used official scale in California.

The following rules have been adopted by the executive Committee of the Los Angeles Chamber of Commerce in reference to the judging of citrus fruits:

No person shall be allowed to serve as judge in any class in which he is an exhibitor.

Any exhibitor who addresses a judge while the latter is in discharge of his duty, will be debarred from competition.

A majority of the judges present shall constitute a quorum for decision in any class.

Preliminary Classification.— Season: Early, from December to April; middle, February to July; late, June to December.

Size: Large; medium; small

(The managing committee from each competing state or section is to nominate varieties to any or all of the above classes, with months, and, when practicable, days, for tests of its own fruit. Fruit to be judged by standards of its class. So far as practicable, no committee is to judge fruit of more than one size, as per above classification.)

ORANGE SCALE TO BE USED.

Divisions of scale: Size, form, colour, weight, peel, fibre, grain, seed, taste; to be considered in order named. Credits to be units and tenths thereof, to be expressed decimally; possible total to equal 100-

1. *Size.* Possible credits, 10.

Standards:	Large,	126's,	$3\frac{1}{4}$ inches in diameter.
	Medium,	176's,	$2\frac{15}{16}$ " " "
	Small,	250's,	$2\frac{7}{16}$ " " "
	Tangerines, etc.,		$2\frac{1}{8}$ " " "

One unit discount for each $\frac{1}{8}$ inch deficiency or excess in any size.

2. *Form.* Possible credits, 5.

Standards: Round, oval, ovate, pyriform.

Discount for lack of symmetry and for form blemishes. Navel marks not to be discounted, except when of abnormal size or bad form.

3. *Colour.* Possible credits, 19, divided as follows; Bloom, 2; peel, 10; flesh, 7.

Standards: Bloom to be perceptible, and to be discounted according to degree of deficiency or of injury thereto; peel to be of rich, deep orange colour, in natural condition, and to be discounted according to degree of deviation therefrom, one or more points; rust, scale and smut to be discounted five to ten points, and fruit that gives visible evidence of having been cleaned of the same to be subject to equal penalty; also peel that has been rubbed or "polished," giving a gloss at the expense of breaking or pressing the oil-cells, to suffer same discount. Flesh to be rich, clear and uniform, in any of the shades common to fine fruit. (Omit consideration of "flesh colour" until after concluding division 5, "peel.")

4. *Weight.* Possible credits, 10.

Standards: Specific gravity, 1, with buoyancy of $\frac{3}{4}$ oz. allowed to "large" fruit, $\frac{1}{2}$ oz. to "medium," and $\frac{1}{4}$ oz. to "small," all without discount.

One point to be discounted for first half-ounce of buoyancy in excess of allowance, and thereafter two points for each additional half-ounce. (*Note*—Buoyancy may be easily determined by clasping weights to the fruits with light rubber bands, and then placing in water.)

5. *Peel.* Possible credits, 10, divided as follows: Finish, 3; protective quality, 7.

Standards: Of finish, smoothness and uniformity of surface, and pleasant touch; of protective quality, firm and elastic texture, abundant compact, and unbroken oil-cells; and $\frac{1}{8}$ to $\frac{3}{16}$ inch thickness

Discount one half point for first $\frac{1}{32}$ inch above maximum or below minimum, and two points for second $\frac{1}{32}$ inch, provided that to long-picked and fully-cured oranges the minimum shall be lowered to $\frac{3}{32}$ inch; and that to fresh-picked and to slightly-cured "large" fruit the maximum shall be raised to $\frac{1}{4}$ inch.

Breaking of oil-cells, breaking of peel and abrasions of same to be subject to one to ten discounts, according to degree.

(Here consider "Colour of Flesh"—see division 3.)

6 *Fibre.* Possible credits, 8

Standards: Septa delicate and translucent; maximum diameter of core, $\frac{3}{16}$ inch in "large" fruit and $\frac{1}{8}$ inch in other.

7. *Grain* Possible credits, 4.

Standards: Fineness, firmness, compactness.

8. *Seed.* Possible credits, 4.

Standards: Absence of seed.

Discount one point for each seed. Each rudiment to be considered as a seed if any growth has been developed; otherwise allowed without discount.

9. *Taste.* Possible credits, 30, divided as follows: sweetness 15: citrus quality, 15

Standards: Clearness and definability of elements, sweetness rich, delicate rather than heavy: citrous quality, pronounced.

Deficiency or absence to be cause for discounts against any element, and excess to be like cause against sweetness, and against acid in "citrous quality."

Staleness and flavours of age or decay to be discounted from aggregate of points in this division.

THE CENTRAL AMERICAN RUBBER TREE.

"The Culture of the Central American Rubber Tree" is the title of a most interesting and useful pamphlet by Prof. O. F. Cook, Botanist in charge of Investigations in Tropical Agriculture for the United States Department of Agriculture.

The following is a summary of the pamphlet:—

"The culture of the Central American rubber tree has passed the experimental stage in the sense that the practicability of the agricultural production of rubber has been demonstrated, but on the other hand it has been ascertained that the tree may thrive where it will yield little or no rubber. Under favourable natural conditions the

culture of *Castilloa** *elastica* bids fair to become very profitable, but the experimental determination of the factors which influence the production of rubber has scarcely begun.

In Southern Mexico and Central America the regions well adapted to the culture of Castilloa are much more limited than has been supposed. The presence of wild Castilloa trees is not a sufficient evidence that a locality is suited to commercial rubber culture.

Differences in the yield of rubber are not due merely to the existence of different species and varieties of Castilloa, but are also controlled by external conditions.

The functions of the rubber milk in the economy of the plant are not well understood or agreed upon by botanists, but there are numerous reasons for holding that in Castilloa and many other plants it aids in resisting drought.

A continuously humid climate is not necessary to the growth and productiveness of Castilloa; the indications are rather that the quantity of milk and the percentage of rubber are both increased by an alternation of wet and dry seasons.

In its wild state Castilloa does not flourish in the denser forests, but requires more open situations. It is confined to forest regions only by the perishability of its seeds.

Castilloa thrives better when planted in the open than in the dense forest; even young seedlings are not injured by full exposure to the sun, providing that the ground does not become too dry.

The planting of Castilloa under shade or in partially cleared forests is to be advised only on account of special conditions or as a means of saving labour and expense.

The loss of the leaves in the dry season may be explained as a protection against drought, and does not indicate conditions unfavourable to the tree or to the production of rubber.

The falling of the leaves of Castilloa elastica in the dry season renders it unsuitable as a shade tree for coffee or cocoa. In continously humid localities where the leaves are retained shade trees are superfluous and the yield of rubber declines.

The desirable features of shade culture, the shading of the soil, and the encouragement of tall upright trunks, are to be secured by planting the rubber trees closer together rather than by the use of special shade trees. Planting closer than 10 feet, however, is of very doubtful expediency.

The percentage of rubber increases during the dry season and diminishes during the wet. The flow of milk is lessened in dry situations by inadequate water supply, but at the beginning of the rains such trees yield milk much more freely than those of continuously humid localities. The claim that more rubber is produced in the forest or by shaded trees seems to rest on tapping experiments made in the dry season.

Continuous humidity being unnecessary, the culture of Castilloa may be undertaken in more salubrious regions than those to which rubber production has been thought to be confined; the experimental

* Prof. Cook prefers the spelling *Castilla*.

planting of Castilloa in Porto Rico and the Phillippines becomes advisable, but extensive planting in untried conditions is hazardous.

No satisfactory implement for the tapping of Castilloa trees has come into use. Boring and suction devices are excluded by the fact that the milk is contained in fine vertical tubes in the bark, which must be cut to permit the milk to escape.

In British India it has been ascertained that the Para rubber tree may be repeatedly tapped on several successive or alternate days by renewing the wounds at the edges. The yield of milk increases for several tappings and the total is unexpectedly large. It is not yet known whether multiple tapping is practicable with Castilloa, or whether this new plan may not give the Para rubber tree a distinct cultural advantage over Castilloa.

The gathering of rubber from trees less than eight years old is not likely to be advantageous; the expense of collecting will be relatively large, and the quality of such rubber is inferior, owing to the large percentage of resin.

The rubber of Castilloa is scarcely inferior to that of Hevea. The supposed inferiority is due to substances which can be removed from the milk by heat and by dilution with water.

CULTIVATION OF POTATOES.

By W. J. Thompson, Travelling Instructor.

Soil.—Any soil that will grow yams will grow potatoes, so long as there is no shade

Before the potatoes are planted the land must be thoroughly forked or dug over to a depth of about 14 inches. If the land is poor then a little green or dry grass manure can be forked into it.

When the land has been prepared and is in a dried state on the surface the potatoes can be planted. The land must be well drained and not too much fresh manure used

If the "early" kind of potato is to be planted, each potato weighing about two ounces, one whole potato can be used for each hole. If the larger kind of potato is to be planted, then one potato weighing, say about four ounces, should be cut into three or four pieces, and care should be taken that the cuts are made so that each part will have two or three eyes in it.

If you select the smaller or early kind of potato for planting, then they should be placed in a shallow tray or box on their ends one against another. This is done to get them to sprout quickly. When they have made sprouts about one inch long they are fit to plant into the ground. Before planting all the young sprouts must be rubbed off, except the two strongest ; even one strong one is enough to leave, but it is better to leave two in case one should get rubbed off. Attention to this part of the work is most important, and if not attended to you will get too many growths. If it is the larger kind being used for planting you can put the cut pieces into the ground as soon as the parts are dried.

The seed potato can either be planted on level ground in small trenches, but on no account must they be planted on ridges or hills as we plant sweet potato.

Whether planted on the level land or in shallow trenches the smaller kinds must be planted about 12 inches apart from each other in the row, and the rows to be about 20 inches apart.

The larger kind must be planted about 15 in. apart from each other in the row, and the rows of this larger kind to be about 30 inches apart from row to row.

The seed potato must be put in the ground about six inches below the surface of the surrounding ground. If the ground has been thoroughly cultivated as recommended, a hole can be made in the ground with a cutlass or a digging bill.

As soon as the growth of the potato begins to show itself, the ground should be kept frequently hoed and kept free from weeds, and as the plant continues to grow the soil should be drawn or moulded up a little at a time. The object of this moulding up is to keep the young tubers covered with soil so as to prevent them getting burnt by the sun. If care is taken to get good, fresh, healthy tubers when planting, to thoroughly cultivate the ground before the potato is planted, to keep the surface of the ground frequently hoed and just enough moulding of soil on the roots, there is not any reason why good returns should not be obtained. The new crop of potatoes should be ripe as soon as the tops begin to die down.

Great care must be taken when planting not to use potatoes for seed grown on the same ground but to get potatoes that have been grown in other districts, or imported ones. This change of seed is not only most important for potatoes, but for tomatoes and all vegetables.

AGRICULTURAL NOTES FOR SCHOOL TEACHERS.

By W. Cradwick, W. Harris, T J. Harris.

Tillage.

No plant can thrive in hard soil, and knowing this we can easily understand how very important it is that every cultivator should learn to dig. By digging and forking the soil is kept soft and loose so that the roots of the plants can easily grow in all directions, the better the roots grow, the better the plants will thrive.

In digging the soil should be turned over, that is, the surface soil which has been exposed to the light and air, and has been made rich by decaying leaves and dead weeds should be turned down underneath where it will keep moist and nourish the little roots of the plants. If the top soil is turned down then the bottom soil is brought up to the surface where it is made richer by exposure to the atmosphere and by the addition of dead leaves and weeds, and at next digging or forking this is in turn buried beneath to feed the tender roots of the plants.

The fork is the better implement for hard ground, and the spade for skilled work in cultivated ground. The finer the soil is broken up in digging the more moisture will it hold. The land should always be thoroughly broken up by plough, fork or spade before planting any crop. Remember that if we thoroughly till the land the plant will take care of itself in so far as its growth is concerned.

Liming.

Lime is one of the most useful agencies in rendering heavy clay land more fertile. Lime is itself a necessary element of the food of plants, but often soils contain a sufficient quantity to supply this need. It acts more by bringing other substances into a proper condition for being absorbed by the roots of plants than by affording nourishment of itself.

The addition of lime to clay soil produces certain chemical effects, and the texture of the soil is greatly improved. In applying lime to the soil it should be used as a top-dressing, or forked in so as to mix it well with the soil. Try it round the roots of coffee when the bushes are suffering from "cacoon" or black "rotten" and the plants will soon be restored to a healthy condition. In all cases remember that lime will not supply the place of food-material, it merely renders this available for the nourishment of plants.

Care of Animals.

The Horse and Mule.—The most remarkable thing about a horse is his memory. Other animals may be stronger, able to run faster, jump higher, or do many things better than the horse, but few animals have better memories. A horse driven over a strange road in the dark will remember it ten years after, although he may have only seen it once. Remember this when you are tempted to strike a horse for nothing or to throw stones at him. All horses and mules require to be cleaned and ticked carefully every morning, this is quite as necessary as food if they are to be kept in good condition. Horses require different kinds of food. A little corn regularly, with "spanish needle," "breadnut," "ramoon," "cane chop," guinea grass, para grass, and any other kind of food to make a variety is better than all corn and guinea grass. Be sure and give the horse water regularly, but not soon after they have had their corn. Horses in hot weather will drink water two or three times in an hour and be all the better for it. Always give them a little rock salt to lick.

Be careful with harness, keep collar pads, saddle cloths, and all parts of harness clean and soft. If a horse or mule gets a bruise rub on it *very gently*, a little Healing Oil. Do not rub a sore in the rough manner that is so usual. This does the sore no good, but hurts the poor animal.

Never let a horse or mule work without shoes; many animals get "gravel" and consequently lockjaw and die through being worked without shoes.

The Cow is an exceedingly nervous animal and should be treated with the greatest kindness.

If dogs hunt, and boys shout at a milking cow, she gets frightened and does not give as much milk as if she is treated kindly. If the cow is fattening, she takes longer to get fat if not treated kindly.

Cows should be carefully "ticked" every morning; a tick killed in time may be the means of preventing the appearance of thousands. Ticks suck the blood out of cows and make them poor; the cows scratch themselves to get rid of the ticks, and get sores which give the owners much trouble to dress and heal. Cows should be groomed the same as a horse. This not only keeps them in good health and makes them

look well, but it makes them tame. The wildest cow if groomed regularly, becomes tame very quickly.

Fruits.

Pine-apples.—In gathering ripe Pine-apples do not cut the stems, but break off each close up to the base of the fruit.

Do not leave the fruits lying in the sun after gathering, but remove them at once to a dry, shady place.

When carrying the fruits to market keep them dry, shade from the sun and be careful not to bruise them in any way.

Do not trim or cut off the crowns; these add to the appearance of the fruits.

Bananas.—In cutting down bananas, do not fell the trees, so that bunches fall on the ground with a crash and get bruised and soiled with earth; cut the stem partly through high up, so that the bunch will come down gently, and can be caught with the hands.

Wrap each bunch carefully in soft trash and handle with great care in carrying them to the depot.

Keep them dry, and shade from the sun as much as possible.

Unbruis d ripe bananas are worth four times as much when they get to England or America as the bruised ones. A small bruise does not show when the bunch is green, but when the fingers ripen, the bruised parts turn black and rots.

Grapes.—Bunches of grapes should be well thinned while the grapes are quite small, about the size of a Gungo pea. A bunch of properly thinned grapes weighs more than an unthinned bunch, and the berries are bigger, finer looking and much sweeter. Unless they are thinned they cannot ripen properly.

Before cutting a bunch of grapes be sure that it is quite ripe. Bunches containing a great many green, or half-ripe berries are of little value.

Line the basket or tray with plenty of nice fresh leaves from the grape-vine and lay the bunches carefully on these.

Do not put too many bunches in the basket or tray or they will squeeze each other and spoil the berries, and never put one bunch on the top of another.

When carrying to market cover the bunches with fine muslin to keep off the dust. Grapes should never be handled except by the stem, and then as little as possible, and with very great care

Citrus. Oranges and Grape Fruits should never be shaken off the trees, but should always be stem cut and gathered by hand, the fruits being placed in padded baskets as they are gathered. All bruised fruits, or those that are injured by prickles should be rejected.

The fruits when gathered should be removed at once to a cool, airy place, and kept quite dry. In sending to market or to the fruit depôt take every possible care not to expose the fruits to sun or rain, and handle them more carefully than eggs, always remembering that one bruised fruit will spoil many others.

Mangoes.—Do not shake mangoes off the trees, for in falling to the ground they get bruised which causes rot to set in, and bruised fruits of any kind are not good.

Gather by hand and place gently in baskets.

If the fruits are for export they should be stem-cut like oranges. Do not expose to the rain, sun or dust.

Naseberries.—Naseberries should be gathered singly by hand, and carefully placed in a bag which the gatherer may take up the tree with him.

When the bag is filled it should not be dropped to the ground, but should be lowered carefully by means of a stout cord or a rope to avoid bruising the fruits contained in it.

Although naseberries are quite hard when gathered, any injury that they receive is plainly seen when they ripen a few days later.

Akees.—Akees should be gathered just when they begin to open. Never gather or eat green, unripe, or stale akees, nor allow any one to eat them as they are then poisonous. Never pick akees from a branch that has been broken or twisted, forced ripe akees are also poisonous.

Avocado Pears.—Pears should be gathered and handled with great care. Any scratch or bruise will cause a pear to rot and it is then not fit for food.

The person who gathers pears should go up the tree with a bag or basket in which he should gently place each fruit as picked, and when he has gathered enough, his bag or basket should be slowly lowered to the ground by means of a rope.

Pears are often much bruised by their own se d if carelessly shaken.

VANILLIN.

Downing Street, 26 February, 1904.

Sir,

I have the honour to transmit, for your information, a copy of a Memorandum which has been prepared at the Imperial Institute on the Production and Manufacture of Vanillin and its employment as a substitute for Vanilla.

I have, &c.,

(Sgd.) Alfred Lyttleton.

Govornor Sir A. W. L. Hemming, G C.M.G.,
&c., &c., &c.

Board of Trade, (Commercial Department)
7, Whitehall Gardens, London, S.W ,
2nd January, 1904.

Sir,

I am directed by the Board of Trade to acknowledge the receipt of your letter of the 1st ultimo, asking for information with regard to "Vanillin," and in reply I am to transmit to you, herewith, copy of a Memorandum on the subject which has been prepared at the Imperial Institute at South Kensington.

I am to suggest for Mr Secretary Lyttleton's consideration that it might be advisable to send copies of this Memorandum to Mauritius and any other Colonies which are largely interested in Vanilla as well as to Seychelles.

I have, &c ,

(Sgd.) H. Llewelyn Smith.

The Under Secretary of State,
Colonial Office.

Imperial Institute,
(South Kensington, London, S.W.)

Memorandum on the manufacture and production of Vanillin and its employment as a substitute for Vanilla.

Vanillin is the constituent to which vanilla owes its aroma and flavour. It was discovered in 1858 by Gobley, and was subsequently investigated by a number of chemists, notably by Tieman, who first prepared it artificially from Coniferin, a glucoside found in certain coniferous plants. Since that time a large number of processes for the artificial preparation of vanillin on a commercial scale have been devised. The first of these to meet with commercial success was that of DeLaire (English Patents: 1890 No. 17547: 1891 No. 17137), who used as a starting point *eugenol,* the substance to which oil of cloves owes its characteristic odour. DeLaire's process, either in its original form or slightly modified, was worked in France by DeLaire & Co., and in Germany by Haarmann and Reimer during the period 1891-1896 apparently under an agreement to avoid competition in prices. About 1897, however, a period of competition set in between the French and German makes, which was further accentuated by additions, in France, Germany and Switzerland, to the number of firms making vanillin. The result has been that the price of this product, which was £9 per lb. in 1890, has steadily fallen until in November last it was quoted at £1 1s. 4d. per lb. It is probable that all the vanillin so far placed on the market has been made from eugenol, and its price has therefore been governed by that of oil of cloves as the raw product. In 1901, however, a patent (No. 310983) was taken out in France by Vigne, in which an electrolytic method for the preparation of vanillin from sugar was described If the claims of the inventor are borne out by practical trials on an industrial scale, it is probable that a further reduction in price may be expected, owing to the great difference in cost of the two raw products, eugenol and sugar.

There is no trustworthy information as to the extent to which artificial vanillin is manufactured and used at the present time, but to judge from the number of firms engaged in its production the amount must be considerable.

As regards the effect of the manufacture and sale of "artificial vanillin" upon the demand for vanilla, it is remarkable that this has up to the present been comparatively slight. When it is considered that vanilla is employed principally as a flavouring agent and that its value in this respect depends upon the amount of vanillin it contains it is curious that so recently as November last, good qualities of vanilla should be saleable at 17/ to 19/6d per lb., whilst the equivalent amount of artificial vanillin for flavouring purposes, could be obtained for about one-thirtieth of this cost It is probable that this preference for vanilla over artificial vanillin is due partly to conservatism on the part of the consumers, and partly also to a somewhat widespread belief that vanillin does not wholly represent the flavour of vanilla, which it is alleged is partly due to minute quantities of other aromatic substances present in the plant. Some evidence in favour of this view is furnished by the statements made at various times by chemists who have examined particular varieties of vanilla, and have isolated in addition to vanillin small quantities of heliotropin, benzoic acid,

&c. These substances are however both cheap and readily obtainable, and if necessity arose it would be a very easy matter to mix them in a proper proportion with vanillin, in order to modify the flavour of the latter in the required direction.

The foregoing statement of the present condition of vanillin manufacture indicates clearly the possibility in the near future of the replacement of vanilla as a flavouring agent by vanillin.

It is difficult to obtain reliable statistics of the production of vanilla since the cultivation of this product is so widely distributed in tropical countries, and the imports of it into the principal consuming countries are comparatively of so little value that they are rarely separately given. The United States Trade Returns for 1902, however, give a table of the imports of vanilla into that country for the decennial period ending in 1902, of which an abstract is given below.

Import of Vanilla into the United States of America.

	Weights. lbs.	Value. $	Average Value per lb.
1894	171,856	727,853	4 2
1896	235,763	1,013,608	4.2
1899	272,[illegible]74	1,235,412	4.5
1900	2[illegible]5,966	1,209,334	4.7
1901	248,988	875,2[illegible]9	3.5
1902	361,739	859,399	2.3

These figures show that although there is at present no falling off in the demand for vanilla, there has been a great decline in value.

The same state of things is shown by the results of the two auctions held in London in February and November of the present year. At the former, 2,800 tins were sold and at the latter 1,410 tins. These quantities are in excess of those of former years. The prices obtained in February ranged from 22/6d. per lb. for best qualities to 14/6d. for somewhat short chocolate coloured beans, and 7/6d. to 11/6d. for "foxy brown" beans. In November the best qualities realised only 17/ to 19/6d. per lb. short beans from 8/6d. to 11/ and poor qualities 4/ to 7/ per lb.

It is almost impossible to give accurately the total annual production of vanilla at the present time, but it may be estimated at about 350 tons, of which about 150 tons are produced in the British Colonies and Bourbon, and the remainder in Mexico. Such statistics as are available indicate that the total production has remained almost stationary during the last few years, the increased output from Seychelles and Mexico being compensated by small exports from Mauritius and Bourbon. This being the case it is evident that the depreciation in value of vanilla must be ascribed almost entirely to the competition of vanillin as a flavouring agent. In this connection it is desirable that it should be known that the so-called "artificial vanillin" is identical in every respect with the vanillin contained in vanilla, and to which the flavour of the plant is chiefly if not entirely due. For this reason it is not possible to encourage proposals to prevent the sale of vanillin as a "substitute" for vanilla.

(Sgd.) WYNDHAM R. DUNSTAN,

29th December, 1903.

A NEW WASH FOR SCALE INSECTS.

Sc le Insects seem to be on the increase in some parts of the Island, and whale oil and kerosene emulsion are reported as not altogether efficacious It may be well, therefore, to try the lime-sulphur-salt wash, that has proved successful in the United States, particularly in the destruction of the San José scale.

The formula is as follow:—

Lime (unslacked)	30 lbs.
Flour of Sulphur	20 lbs.
Common Salt	15 lbs.
Water	60 gallons

The mixture may be made according to the following plan*: Place about one-fourth of the water in an *iron* kettle and bring to a boil. When the boiling point is reached, add the unslaked lime, and during the consequent violent boiling add the sulphur (which should previously have been mixed with water) and keep well stirred A few minutes later add the salt and continue the boiling for two hours. Water may have to be added from time to time to make up for evaporation—sufficient water should be kept in the kettle to prevent "burning," but more than this is not desirable. At the end of the two hours add water to make 60 gallons and strain through a fine mesh iron strainer. Apply while still hot.

In Connecticut, the method of making the wash is as follows†:— The materials are weighed out, the lime slaked, the sulphur and salt added with enough water to cover, and the whole boiled in a kettle for an hour or two. The water was then added, and the mixture applied while fresh.

In Illinois, Prof. Forbes' method is: –

" Provide 30 pounds of the best unslaked lime, 30 pounds of commercial powdered sulphur, and 30 pounds of salt, and water sufficient to make 100 gallons Heat about five gallons of water in an iron kettle, and while this is heating, weigh out the lime and sift the sulphur, keeping the two separate. When the water is ready to boil, put in the lime, and as soon as this begins to slake, pour in the sulphur. one man stirring the mass during the operation.

" A violent boiling immediately takes place, and water, preferably hot—should be kept at hand to pour on the boiling mass to prevent its running over the kettle. When the lime has finished slaking, the violent boiling ceases and then the mass should be thick and stiff. Keep it steadily boiling for an hour, or until the lime and sulphur have thoroughly entered iuto combination. The mixture will get thinner as it boils down, and change from a deep orange through several shades of yellow, ending with a deep amber colour Now add the 30 pounds of salt and boil 15 or 20 minutes longer, steadily stirring. Then fill the kettle with hot water, stir thoroughly, strain half the contents into a barrel and fill this up with hot water, and spray upon the trees immediately. The remainder of the mixture in the kettle should

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*Georgia State Board of Entomology, Bulletin No. 8, 1903.

† Connecticut Experiment Station Report 1902.

be kept warm, but not necessarily at the boiling point, until ready for the next barrel of spray.

"The points of the main importance in this process are the following: The water must be hot when the lime is put into the kettle; the the lime must be slaking when the sulphur is added; the mixture must be constantly stirred; a minimum amount of water must be used; and the mixture must be kept actually boiling and not merely simmering."

As the mixture is corrosive, the hands should be protected with gloves. Use a mop or brush with a good handle and apply the mixture to the stem and large branches of the trees.

At the end of the season when the fruit is over, and before the tree begins to bud again, the mixture may be applied to the whole tree by means of a spray pump. The leaves will drop off, but the tree will soon bud again.

In large orchards the mixture can be made most economically and rapidly by using live steam, and boiling the material in tanks or barrels.

This wash has a corrosive action also on brass and copper, but pumps can be used with a minimum amount of corroding, if they be thoroughly washed out with clear water after each day's spraying.

EGYPTIAN IRRIGATION.

A pamphlet by Clarence T. Johnson, Assistant Chief Irrigation Investigations, of the United States Department of Agriculture, has lately been issued on "Egyptian Irrigation: a Study of Irrigation Methods and Administration in Egypt." It is illustrated by maps, plans and photographs. The conclusions arrived at, after the full investigation recorded in the pamphlet are as follows:—

The climate of Egypt being mild, the needs of the people are easily satisfied; the population is dense and the individual holdings of land are small. Labour is cheap, enabling much to be accomplished by the use of crude implements which could be performed profitably in America only by the employment of modern machinery. The irrigation canals of Egypt convey water to the farms, but the irrigator must must raise the water for his fields. He has few other duties which demand his time and energy during the growing season, and therefore can use with profit, machinery which requires a large expenditure of labour but little expenditure of money. In lifting water from the Nile, the Egyptian deals with the same obstacles as the irrigator in many localities in the West where water can be secured at depths ranging from 10 to 25 feet, but there the resemblance ceases. The standard of living of the American irrigator is higher, his farm is larger and the returns from an acre are less He cannot adopt water-raising devices of low efficiency like the shaduf or natali. The hoe, practically the only tool used in distributing water over the fields in Egypt, has no merit to the American farmer. We cannot therefore, learn much from the Egyptian irrigator.

Many of the irrigation structures of Egypt are models of their kind. The barrage below Cairo is one of the most interesting dams in the world. Its architecture reflects some of the recent political struggles in Egypt. The towers which embellish the dam should be classed with the ruins bequeathed to the modern world by ancient Egypt. The bar-

rage is a monument to the French engineers, while the fortifications along it remind us that it was only a few years ago that the caprice of the Khedive overshadowed the designs of the engineer. The Assint dam follows the general plan of the barrage below Cairo. The design of the dam at Assuan is new in Egypt as well as in the world. It marks the beginning of a great reservoir system which will ultimately control the waters of the Nile and furnish a supply to every arable district of Egypt. The head gates, waste gates, regulators, and bridges of the larger canals will always be objects of study for irrigation engineers of other countries.

The excellence of the recent irrigation works of Egypt is beyond question. The fame of the dam at Assuan has been heralded throughout the civilized world; but such works are costly. Before the distributary systems are perfected the cost of the system supplied by the Assuan reservoir will exceed $57 pe acre of land irrigated. Such an outlay is not at present profitable in the United States. It is advisable, nevertheless, for us to study the larger irrigation works of Egypt, because it may be possible for American engineers to modify these designs to suit the needs of irrigation here. Many of the smaller details of construction can be readily introduced.

The Nile is an easy stream to divide, hence laws for the economical distribution of water are not so severely tested as they will be on the stream of the arid West. Water is diverted only at the lower end of the Nile, and not from all its ramifying tributaries, as is the case on the Missouri and Colorado. In addition, Egypt is one of the few countries where the water supply can be made adequate for the needs of all by storage. This will not be possible in the United States except under rare conditions, where the area of irrigable land along a river affording the supply is comparatively limited. In Egypt the demand for land will in a few years exceed the demand for water. With us the area of irrigable land will ultimately be limited by the water supply.

The Egyptian irrigation law aims to bring about such a distribution of the water of the Nile that the country as a whole will produce the the largest returns and the treasury receipts be the greatest. The irrigation laws of the Western States of the United States are framed to protect the individual farmer, and not for the purpose of producing revenue. This fundamental difference in the objects to be attained makes Egypt's administrative system inapplicable to this country. There does not seem to be any reason for changing our policy. On the contrary, it seems wise that our irrigation administration should promote the prosperity of the water user as far as practicable, so that we may say in the words Ameni, as inscribed on his tomb at Beni Hassan, 50 miles above Cairo, "And behold, when the inundation was great, and the owners of the land became rich thereby, I laid no additional tax upon the fields."

PROMOTION OF MR. T. J. HARRIS.

Mr. T. J. Harris, Agricultural Instructor and Assistant Superintendent at Hope Gardens, has been selected by His Excellency Sir H. L. Geary, Governor of Bermuda, for the post of Superintendent of the Public Gardens of that Colony.

The duties are to take charge of the Public Garden—an Agricultural Experiment Station, established for the improvement of agriculture in Bermuda, the education of the farmers in better methods, and the introduction of new profitable crops.

The salary is at the rate of £300 per annum with house and with fees for inspecting imported bulbs.

Mr. Harris's work in Jamaica has been of a similar nature, and it is due to the satisfactory way in which his work has been done, that he has received the appointment. He has been successful in the special work assigned to him at Hope Gardens of working out the details involved in the art of growing and curing both Havana and Sumatra tobacco, in hybridising Pine Apples and growing the seedlings, &c. After two or three years of constant experiment for the Director, he has found out how to bud the Mango. By the same method he has budded Cocoa which is of enormous importance to cocoa planters in every land,—in fact it is an epoch marking discovery in cocoa growing. The system has been extended to the budding of Nutmegs, Avocado Pear, Sapodilla, &c

Mr. Harris has taught the principles of practical agriculture to the Hope Industrial boys, the garden apprentices, the students at the Mico and Shortwood Training Colleges, students at the Laboratory, and has assisted in the Teachers' annual course at Hope and the Mico, besides acting as Superintendent of the Gardens in the absence of Mr. William Harris.

He takes with him the good wishes of his colleagues and those who have benefited by his instructions.

W. FAWCETT,
Director of Public Gardens and Plantations.

THE STORY OF THE PAPAW. III.

By F. B. KILMER.*

(Continued from Bulletin for April.)

THE FERMENTS OF THE PAPAW. *(continued.)*

The ferment may be extracted from the dried milk by water or glycerine (neutral, acid or alkaline), by very dilute alcohol (5—100); and from such a solution may be precipitated by any of the usual methods, such an excess of full strength alcohol, saturation with alkaline salts, etc.

The following are the most important of the practical methods of separation. The first three are the methods of Peckholt:

(1) Exhaust the juice with ether; then exhaust the residue, first with absolute alcohol and next with 80 per cent. alcohol; the dried residue is then treated with water which dissolves it almost entirely forming a turbid solution. The waterly solution is finally precipitated with alcohol; the precipitate washed with alcohol, and dried over calci-

*Reprinted from the "American Journal of Pharmacy."

um chloride. Peckholt obtained by this process 7·848 per cent. of a white, light amorphus powder which he called "papayotin."

(2) Mix the juice with four times its weight of water; filter, and precipitate with alcohol (95 per cent.): wash and dry the precipitate. This gives 3·762 per cent. of a product practically the same as (1) but not quite so light.

(3) Evaporate the latex to dryness and then completely exhaust with ether and alcohol (absolute), as in the first method. Dissolve the residue in water and precipitate with alcohol. The result being a light brown powder of which Peckholt obtained 5·338 per cent. (He called this "parapayotin.")

(4) Wurtz prepared the ferment as follows: The milky juice was thrown on a filter and the coagulum washed with water The aqueous solution then obtained was reduced to a small volume in a vacuum, and was precipitated by ten times its volume of alcohol. This precipitate was dried, dissolved in water and precipitated a second time with alcohol, washed with absolute alcohol and dried in a vacuum. The product of this process he called "papain."

(5) A method now in actual use in one of the West India Islands is as follows: Pour into the strained latex five times its volume of full strength alcohol, collect the precipitate and wash with absolute alcohol; dry over calcium chloride or sulphuric acid. (There is a considerable loss of alcohol; the product is small, fairly active, but high priced.)

(6) Method devised by the author: Dry the latex without heat; exhaust the dry residue first with ether, then with chloroform, followed by benzine; finally extract with alcohol. Under this process, if the extraction is thoroughly carried out, everything is removed except the proteids and ash. The product is a fine grey-white amorphus powder almost completely soluble in water, more active and more nearly representative of the peculiar properties of the latex than the product resulting from any other method which has come under observation.

(7) Salt-precipitation method. The well-known methods of precipitation by alkaline salts are applicable to the separation of the papaw ferments. The latex diluted with water or the dried latex extracted with water (filtered), when saturated with sodium chloride, with ammonium sulphate or with magnesium sulphate, will yield a heavy precipitate of the proteid contents carrying the greater portion of the ferments. Such precipitates may be freed from salts by subjecting their solution to dialysis, the resulting solution (and precipitate residue) are then to be evaporated to dryness.

The yield from these salt-precipitation methods is small, but, if the processes are carefully performed, furnish a satisfactery product, weaker however in action than those perpared by the method outlined in the preceding section.

Something like thirty methods for separation have been tried in my researches, with the result that all methods where precipitation is involved, tend to weaken the digestive power of the ferment. The methods used in the separation of pepsin whereby a purified and high power pepsin is produced, are as follows: Digestion of the proteid constituents, precipitation and purification of the product do not seem to be applicable to the papaw.

If the proteids of the papaw are digested by the aid of the contained ferments in either acid, neutral or alkaline fluids, and a separation and purification then made, the resulting product is decreased, and the digestive power is not increased; in fact, unless the process is most carefully performed, the absolute power of the ferment is greatly weakened.

It has been stated that the ferments of the papaw are chiefly associated with one of its proteid constituents.[17]

I have never been able to verify this statement. When any of the various forms of proteids are separated by the processes elsewhere outlined, heat or coagulation excepted, the separated body will be found to possess ferment power. Even the peptone remaining after separation of the albumoses exhibits feeble ferment powers. The ferment action seems to be the most marked when all of the proteids are associated together in their natural form.

GLUCOSIDE OF THE PAPAW.

The *Carica Papaya* contains a glucosidal body, caricin. This I have never been able to obtain except from the seed, in which it is fairly abundant. From this source it may be extracted after boiling the seeds with 75 per cent. alcohol. The residue after alcoholic extraction is then exhausted with water. The aqueous extract after the addition of barium carbonate is evaporated to the consistency of a soft extract from which the glucoside may be extracted with hot alcohol. From such a solution the glucoside separates upon concentration. This glucoside resembles sinigrin.

It is decomposed by the glucoside splitting ferment, myrosin (obtained from mustard), giving a volatile, odorous, pungent flavour suggestive of the Cruciferae, but not so marked.

The seeds of papaw also contain the glucoside splitting ferment, myrosin. The glucoside resides within the hard inner coating of the seed, while the myrosin ferment is secreted in the gelatinous outer envelope. Myrosin may be extracted from this mucilaginous substance with water and precipitated from the watery solution by alcohol.

By pursuing the methods here briefly outlined, we may separate the glucoside from the inner section of the seed and the ferment from the outer coating; and by bringing the two substances together in the presence of water, the glucoside will be decomposed with the production of a volatile essence and glucose.[18]

The myrosin ferment extracted from the mucilaginous coating of the papaw seed will decompose sinigrin. The action of this ferment and decomposition of the glucoside is apparent to the sense of taste when the seeds are chewed. The taste and odour indicate that the glucoside and ferment are present in the bark of the root.

ALKALOID.

An alkaloid—carpaine—has been separated from the *Carica Papaya*. The source so far noted has been the leaves.

The usual method of extraction is to digest the leaves in alcohol

(17) Martin believed the ferment to be associated with the proteid which he termed B Phytoalbumose.

(18) It has been demonstrated that in many instances the ferment and the glucoside upon which the ferment acts are enclosed in different cells in plant tissue.

acidulated with hydrochloric acid (5–100); evaporate the extract, wash with water acidulated with hydrochloric acid (2–100). This solution is then washed with ether; made alkaline with sodium hydrate and the alkaloid washed out in chloroform or ether. In my experiments the yield was small. I have noted indications of alkaloidal reaction with Mayer's reagent in the alkaline ether washings, from the latex, but it cannot be stated that the alkaloid is present in this product.

The alkaloid, carpaine, is soluble in absolute alcohol, amylic alcohol, chloroform, benzine and in water acidulated with hydrochloric acid.

A solution of carpaine reacts with indicators as follows:—red litmus paper is turned blue; hæmatoxylin, deep rose or wine; rosolic acid, deep rose; cochineal deep rose; methyl-orange, yellow; lacmoid, no change. Phenolphtalein causes a turbidity with the usual red, but the reaction is obscure in the presence of alcohol.

The physiological action of this alkaloid is quite similar to that of digitalis, a heart depressant.

MARKET PREPARATIONS OF THE PAPAW.

There are numerous preparations in our own and in the European markets claiming to be the ferment of the papaw. These are sold under the name of "papain," "papayotin," "caroid," "papoid," etc.

From a somewhat extended examination I am quite satisfied that several of the preparations named are the dried and powdered papaw milk. In this case they bear the same relation to the true separated ferment as the dried mucous membrane of the stomach might bear to purified pepsin. Some of these so called papains retain the waxy, rubber-like constituents and the acrid, irritating resins of the milk.

The application to such crude material of the term "papain," or any similar name which would imply the isolated ferment, is misleading and should be abandoned. The dried juice of the papaw, or a mixture of the dried juice with any other ferments, should be properly labelled. From these crude preparations, the true ferment can be separated by extraction with water and precipitation with alcohol. In a few experiments which I have tried, some of the crude preparations were found to contain about twenty per cent. of the ferment-bearing bodies (albuminous).

There are, however, preparations in the market which consist of the more or less purified and separated ferment, or, more accurately speaking, consisting of the separated proteids; with which the ferments are associated.

I know of no standard by which these marked preparations can be judged. They vary greatly in their proteolytic action. In such as may be prepared by simple drying of the milk, no two lots can be alike. These will be found to vary in colour, to emit an offensive odour and to have a marked acrid disagreeable taste, producing in several instances in my experience, quite a sharp caustic action.

The dried papaw juice is usually the more energetic in the beginning of digestive action than is the purified ferment, but this energetic action of the dried juice apparently soon ceases, while the pure ferment, though slower in immediate action, continues its activity for many hours. Upon treating the preparations made of the dried juice with ether, chloroform, benzine or alcohol, evaporating the solvent, the waxy resinous and rubber-like residue elsewhere spoken of will remain.

The amount of residue left after extraction with water may be taken as a rough estimate of the foreign material present, the ferment itself being associated with a more or less soluble albumose. A more accurate method of estimation as to the amount of ferment-bearing bodies is as follows:—Extract a weighed portion of the powder with water (two or three successive portions with trituration); combine the aqueous solutions and saturate with crystals of magnesium sulphate and sodium sulphate in about equal proportions. If the solution is warmed the precipitate will be quicker. The precipitate thus obtained, freed from salts by dialysis, will consist of albumose and globulin, and the weight of these when dried will give the measure of soluble bodies with which the ferment is associated, or the amount of ferment-bearing bodies in the sample.

In the best of the market preparations which I have examined I have found, in addition to these soluble bodies, insoluble globulins and an appreciable amount of peptone, the latter not being precipitated by the foregoing methods.

Digestive Action.

The digestive action of the ferment of the papaw plant has been quite fully described. The actions which are summarized have been made with one of the market ferments sold under the name of "Papoid."[19]

Papoid is a German production, and, according to the statement of the manufacturors, it is prepared by precipitation from a watery extract of the papaw juice or milk. It consists essentially of globulin and albumose, associated with the ferments, and in addition it contains a small amount of natural inorganic salts. This preparation was used by the writer in a previous communication, and by Chittenden, (See "Papoid Digestion" Transactions of Connecticut Academy, Vol. IX, 1892.)

The action of this ferment presents features which contrast peculiarly with those of the ordinary digestive ferments. Direct comparison of the enzyme of the papaw with any other ferment is practically impossible, and this is especially true as to its behaviour in comparison with the animal ferments.

The action of most ferments is inhibited by the products of digestive action; such does not seem to be the effect in the case of the papaw enzyme. It acts in a concentrated solution, even when carrying products of its own action. Certain of my experiments tend to show, however, that this enzyme has a notable action in a stream of running water. In other words, its action seems to be continuous, and the ferment is not removed by washing or by the action of fluids in which it is soluble. One such experiment was as follows:—

Two ounces of raw lean beef were cut into slices, over which was poured an alkaline solution of the papaw ferments. The beef was allowed to remain in this solution for half an hour, during which time the solution was fairly well absorbed and the beef somewhat softened. The whole was then wrapped in a filter paper, transferred to a fine

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19 This proparation was used on account of its convenience and because of the lack of sufficient material, separated by the processes outlined in another part of this paper.

muslin bag; this bag and contents were placed under a faucet of running water and allowed to remain for five hours. Upon opening the bag it was found that only a few shreds of meat remained.

In order to demonstrate that the action was not that of a washing away process due to force of the water, a check experiment was made without the ferment, here the loss in weight only amounted to about fifty per cent.

This experiment seems to show that the enzyme combined with and hydrated the fibres of the meat. The products of this combination are soluble, and are removed by the action of water or other fluids; furthermore, in the process of washing away the soluble products, the ferment is left behind to act upon a fresh portion of the fibre, in turn giving rise to soluble products or peptones.

This experiment was made in order to imitate certain known conditions present in the process of digestion, where there is a constant stream of fluid in the intestinal tract. Taken with other experiments this result seems to show that ferments of the papaw act very energetically in a small amount of fluid, and will also act in a stream of water.

The influence of reaction upon the ferments of the papaw form an interesting comparison with those of the animal ferments.

The power of pepsin is destroyed in alkaline solution, such as lime water, sodium bicarbonate, ammonia, etc.; on the other hand the activity of pancreatin, ptyalin or distaste is inhibited in acid solution. The papaw enzyme is active in acid, neutral or alkaline solution; but pepsin and pancreatin cannot be mixed together in solution either acid, alkaline or neutral, and still preserve their characteristics; whereas, the ferments of the papaw can be mixed with other ferments in a solution of any reaction. Pepsin is inert in a neutral solution, and is destroyed in solutions containing traces of alkalinity. If an alkaline solution of pepsin be made acid, the pepsin action is not restored; pancreatin acts slowly in neutral solutions, and is destroyed in acid solution. If an acid solution of pancreatin be made alkaline, the pancreatin action will not be restored. The papaw ferments are active in neutral solutions; their activity is enhanced when such solution is made acid, and if such acid solution be in turn made alkaline, the ferment will still remain active. In fact, the changing of solution of the papaw ferments from acid to neutral, then to alkaline; then reversing the order to neutral, acid and alkaline, or in fact, changing the order of reaction almost indefinitely, does not thereby destroy the ferment which seems to remain active under all reactions and conditions.

Certain physical changes in the proteid substances acted upon are characteristic of these enzymes of the papaw. For instance: when raw blood fibrin or raw beef is acted upon with an alkaline solution of these ferments, there is an immediate softening to a jelly-like mass in which the fibres lose their individuality, this jelly gradually becoming thinner under the further action of the ferment.[20]

In the case of cooked beef in either alkaline or acid solution, the ac-

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[20] This action in the case of blood fibrin is quite striking, and advantage is taken of this property in theraputics where a solution of the ferments is used as a solvent for the false membrane of diphtheria, a substance quite analogous to blood fibrin.

tion of the ferment of the papaw is quite different. There is a rapid disintegration of the fibres which separate into tiny fragments. Finally the undigested portion becomes a pultaceous residue.[21]

A most interesting feature of the papaw enzyme is its action at a wide range of temperature. With the animal ferments, especially pepsin and trypsin, digestion is very slow at room temperature, 68 to 70 F. While at this temperature the papaw enzyme acts as energetically as at 110 F., the animal ferments act most energetically at body temperature (diastase at 130 F.)

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Head Quarter House on the 12th inst., at which there were present: The Hon. Colonial Secretary, Chairman; the Director of Public Gardens, theChemist, His Grace the Archbishop, Hon. H. Cork, Mr. C. A. T. Fursdon, and the Secretary, Mr. J. Barclay.

The minutes of the previous meeting were read and confirmed.

The Chairman intimated that Sir Daniel Morris had a cotton expert visiting Barbados and other islands and advising generally on the industry. He had arranged that this expert, Mr. Seabrook, should spend a fortnight here in May, to give advice, especially on ginning. He would thus be able to set up the gin at Mr. Fursdon's property.

Mr. Cork asked if there was any experimenting going on with the different local varieties, as there might be found a first class hardy cotton for our local conditions. The Director of Public Gardens was asked to make enquiry of the local instructors and others about native varieties.

Regarding the proposed arrangement between the Director of Public Gardens and Mr. W. G. Clark of Gordon Town, for the latter to lease a portion of the grounds at Hope, partly used at present as the Port Royal Mountains Agricultural Society's Show ground, it was resolved to retain the land in the hands of the Government.

A suggestion from the Chemist was submitted to utilize all the ruinate land at Hope to provide hay and pasture so as to support a self-contained service of draft stock and to utilize the considerable flow of waste water which for nine months in the year is not used. One of his suggestions that the Board of Agriculture should possess a strong travelling buggy of its own for use of its officers was not approved.

A minute from the Secretary reporting that he had received up to date orders for 6,900 lbs. of cotton seed, 2,400 lbs. of which had already been sent out, was submitted. As further orders were being received daily he would require more seed. The Director of Public Gardens reported that half a ton had been cabled for and ought soon to be received.

A letter from Mr C. A T. Fursdon, enclosing letters he had received about damage done by scale insects around Hartlands, and let-

[21] It is notable that with meat proteids, both cooked and uncooked, in acid or alkaline solutions containing no ferment, there is a marked swelling of the fibre. In an alkaline solution this becomes a solid jelly, but this swelling seems to be entirely counteracted by the presence of the papaw ferment.

ters showing them to be in greater numbers than ever before, which had been received by the Director of Public Gardens, were submitted.

The Director of Public Gardens suggested the lime and sulphur wash which was in favour for destroying scale insects in the United States.

A suggestion to treat trees by hydrocyanic gas, and for the Board to procure a tent for the purpose of doing so, was submitted, but was not adopted. The Chairman said the Government had no funds to provide the tents, and the gas to treat each tree would cost 2s. 9d., which was prohibitive.

A suggestion to introduce the variety of lady bird beetle, which the U. S. Department of Agriculture had introduced into that country for the San Jose scale was considered and the Director of Public Gardens stated that it was not abundant enough yet for distribution in the States. The Director was asked to make enquiries on the subject of the lady bird beetles here.

The Chemist submitted minutes as follows :—

Application from Mr. Altamont DeCordova for admission into the Agricultural course. Approved.

Application for appointment of three laboratory assistants for sugar experiments to be paid out of the Imperial grant. Approved.

The appointment of a committee to co-operate with him in his sugar experiments. Approved.

A suggestion to start correspondence classes in agriculture was not adopted. A suggestion *re* Model School Gardens was referred to the Superintending Inspector of Schools.

Communications regarding fungus on cotton at Hope and letters from Sir Daniel Morris on the subject, suggesting treatment of cotton seed for planting by soaking in a solution of corrosive sublimate were dealt with

Suggestion *re* King's Purse for raising stock for the year 1905. The Chairman said the matter was being dealt with by the Agricultural Society.

The following reports were directed to be circulated by the Society.

From the Chemist :—Report on the work of Sugar Experiments (1) By the Fermentation Chemist. (2) By the Superintendent of sugar experiments

Analyses obtained from manurial plots.

Report on seedling cane. Minute reporting successful results with thymol as a cure for worms in horses.

From the Director of Public Gardens :—

Report on Hope Experiment Station between 12th March and 9th April.

Report by Mr. W. J. Thompson on his weighing of canes on sugar estates.

The Board adjourned.

[Issued 14th May, 1904.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. JUNE, 1904. Part 6.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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KINGSTON, JAMAICA:
Hope Gardens.

1904.

JAMAICA.

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MANURIAL EXPERIMENTS ON SUGAR CANE IN 1903.

Part I.

By H. H. Cousins, M.A., F.C.S., Island Chemist.

The results of the experiments on 6 estates have been obtained to date with the ratoon crop of 1903, following the first series of experiments with plants in 1902.

The work of supervision of these experiments has now been specially provided for by the appointment of Mr. T. H Sharp, Jr., B.S.A. as Superintendent of Sugar Experiments.

Albion Estate, St. Thomas—J. Grinan, Esq.

The results with D. 95 1st ratoons agree with those obtained last year. The manures show a general increase in all cases. A manure consisting of 6 cwt. of a mixture of 3 parts superphosphate with 2 parts steamed bone flour, 1 cwt. Sulphate of Ammonia and ½ cwt. Sulphate of Potash per acre costing 56/ increased the yield by 11 tons of cane at 10/ per ton (value of cane to the estate). This manure shows a profit of 44/ per acre. Half a ton of Lime per acre yielded an increase of 3.5 tons cane.

With Mont Blanc canes, the results are quite different Last year the manures produced no results; with the ratoon crop some of the plots show an increase but not a profitable one while others show a deficit both in tonnage and in cost.

A new series of plots has been arranged here as the old ones were not considered altogether satisfactory or uniform. Thanks are due to J. Grinan Esq., and to the Manager for their generous co-operation in these experiments.

Albion Estate.
Plots $\frac{1}{10}$th acre. 1st Ratoons.

Plot.	Description.	Tons per Acre. Canes.	Tops.	Total.	Increase. Tons Canes.	Cost per Acre.		
	D. 95							
1	No Manure	12.5	7.5	20	—			
2	Complete	18.75	8	26.75	6.25	38/2	Juice by estate mill	70 o/o
3	No Nitrogen	18.5	7.5	26	6	24/5	Brix	19.5
4	Double "	17	7	24	4.5	51/1	Sp. gr.	1.0769
5	No Phosphate	20	8	28	7.5	20/4	Sucrose lbs. p. g.	1.9036
6	Double "	23.5	8.5	32	11	56/	Glucose " "	.0570
7	" Super	18.25	6.75	25	5.75	56/	Non sugars " "	.1594
8	" Slag	17	6	23	4.5	38/6	Quotient purity	92.13
9	No Potash	19	6.62	25.62	6.5	31/7	Glucose ratio	2.98
10	Double Potash	18	6.12	24.12	5.5	14/9		
11	Double Complete	19	6.5	25.5	6.5	76/4		
12	Lime	16	5	21	3.5	10/		
—	*Mont Blanc—*							
1	No Manure	17.62	7.5	25.12	—			
2	Complete	20	8	28	+2.38	Cost similar to above.	Juice by estate mill	69.5
3	No Nitrogen	24	9	33	+6.38		Brix	17.8
4	Double "	20	9.5	29.5	+2.38		Sp. gr.	1.0697
5	No Phosphate	20.25	8.5	28.75	+2.63		Sucrose lbs. per gal.	1.6536
6	Double "	20.25	7.5	27.75	+2.6		Glucose " "	.0769
7	" Super	13.5	2.75	16.25	4.12		Non sugars " "	.1735
8	" Slag	15	4	19	—2.62		Quotient purity	86.84
9	No Potash	12	3.5	15.5	—5.62			
10	Double "	14.62	7.5	22.12	—3		Glucose ratio	4.04
11	Double Complete	11.25	5.5	16.75	+6.37			
12	Lime	10	4.5	14.5	—7.62			

Holland Estate, St. Elizabeth.—*M. H. M. Farquharson, Esq.*

The returns from the ratoons were considerably less than from the plants which yielded a very high tonnage in 1902.

The plots throughout confirm the results previously obtained, all the manured plots show an increase and, with the exception of the pen manure, a profit on manuring The largest crop was obtained from the same plot as last year which received 3 cwt. of slag, $1\frac{1}{2}$ cwt. of Nitrate of Soda and 1 cwt. of Muriate of Potash. This year, however, the increase of Potash from $\frac{1}{2}$ to 1 cwt over plot 2 has not resulted in a profit.

Both the omission of Phosphate and its increase from 3 to 6 cwt. per acre resulted in a reduced profit. The omission of Nitrogen resulted in a reduction in the yield and a small loss on that account while the doubling of the Nitrate of Soda did not increase the yield and resulted in a reduced profit. So far as chemical manures are concerned the complete manure on plot 2, as originally designed by the writer as a suitable manure for this soil, has justified itself both on the plants and ratoons.

Very striking results are those with lime and cow-peas, each used separately. Half a ton of lime per acre has increased the crop by

nearly 25 tons *showing a profit of £11 18s. 0d. per acre.* The cow-peas also show a good return and yield a profit of £7 15s. 0d. A combination of lime and cow-peas indicates itself as probably the most profitable manurial treatment that this soil could receive. Were I the owner of this property, I should certainly try this on a large scale on the strength of the results already obtained.

The wonderful effects of deep drainage on this flat, stiff land is strikingly shown by a neighbouring plot so treated that has given a return of 51.76 tons canes or an apparent increase of nearly *40 tons canes per acre due to drainage alone.* These figures are significant of much. They indicate that the yield on this estate, despite long years of cane cultivation, can be increased enormously by drainage, by liming, by the growth of leguminous dressings and with due caution and judgment, the use of a little complete chemical manure. I desire to express my thanks to Mr. Farquharson for the care and trouble he has taken with these experiments Mr. Cradwick supervised the weighing of the plots.

Holland Estate -- St. Elizabeth.

1st Ratoons. 12½ months old. Plots 27.5 per acre.

Plot.	Manuring.	Cost per Acre.	Tons per Acre. Canes.	Tops.	Total.	Increase Tons Canes.	Profit per Acre. 1 Ton Cane = 10/.
1	No Manure .	...	13.00	10.64	23 64	—	—
9	No Manure .	...	10.89	5.78	16.67	—	—
Average	No Manure .	...	11.94	8.21	20.15	—	—
2	Complete .	31/1	38 25	12.33	50.58	26.31	232/
3	No Nitrogen .	15/10	36.44	14.95	51.39	24.50	229/
4	Double Nitrogen	46/4	35.53	14.83	50.36	23.59	190/
5	No Phosphate .	21/7	19.39	7.48	26.87	7.45	53/
6	Double Phosphate	40/7	22.30	10.48	32.78	10.36	63/
7	No Potash .	24/9	19.51	10.1	29.61	7.57	51/
8	Double Potash	37/5	38.79	17.18	55 97	26 85	231/
10	Cow-peas ..	10/	28.48	13 87	42.35	16.54	155/
11	Lime ...	10/	36.82	13 87	50.69	24 88	238/
12	Pen Manure .	120/	18.4	7 00	25 41	6.47	*loss* 55/

Rainfall during growth of crop—79.75 inches.

Juice Analysis.

Juice extracted by estate mills	69.29	Glucose lbs. per gallon	.0518
Brix ...	16.7	Non Sugars do.	.1558
Specific Gravity ...	1.0649	Quotient of Purity	88.32
Sucrose lbs. per gallon ...	1.5704	Glucose Ratio	3.29

VERE.

Hillside Estate—F. M. Ellis, Esqr.

The manures applied here were the same as at Holland, plot 2 receiving 3 cwt. Basic Slag, 1½ cwt. Nitrate of Soda and ½ cwt. Muriate of Potash, costing / per acre. All the plots receiving manure show an increase save the Double Phosphate. Analysis shows this soil to be

very rich in Phosphates. Plot 5 receiving Nitrate and Potash only at a cost of 21/6 per acre gave an increase of 10 tons cane showing a profit of nearly £4 per acre. The results of applying half a ton of Lime per acre are most gratifying, showing an increase of 12 tons cane and a profit of £5 10s 0d. per acre.

The juice obtained from Hillside is worthy of special notice. Recently Professor Wiley, Chief Chemist of the Department of Agriculture, U.S.A., recorded the analysis of an extraordinary juice from canes grown in the Southern States. The canes were chemically ripe and the juice absolutely devoid of glucose. An identical result has now been obtained from Hillside Estate in Vere under conditions of limited irrigation. This juice contained absolutely no glucose at all and the canes must have attained a state of complete chemical maturation.

Water would turn Vere into one of the richest areas in Jamaica—there is ample security for any reasonable cost in establishing irrigation works equal to the demands of the area on the one hand and the possibilities of nature on the other.

Hillside Plants, March '03—cut April '04.
Plots $\frac{1}{10}$th acre under irrigation control.

Plot.	Description.	Tons per Acre. Canes.	Tops.	Total	Increase. Canes.	Rainfall.	
						1903, April, May, June,	Nil.
1	No Manure	19	13.5	32.5	—	July	.39
2	Complete	21	12.25	33 25	2	Aug.	13.51
3	No Nitrogen	22.75	11.5	34.25	3 75	Sept.	1.23
4	Double Nitrogen	27.5	10.5	38	8.5	Oct.	1.18
5	No Phosphate	29	12	41	10	Nov.	1.73
6	Double "	18	11 5	29.5	—1	Dec.	1.30
7	No Potash	24	14.25	38 25	5	1904, Jan.	1.24
8	Double "	22 75	11.5	34.25	3.75	Feb.	.28
9	Double Complete	26.5	12	38.5	7.5	March	3.13
10	Lime 10 cwt.	31	11.5	42 5	12	April	20
							24.9 in.

Juice expressed by mill	59.56 o/o	Sucrose lbs per gall.	1.9448
Brix corr.	20.33	Solids Non-Sugars "	.2182
Sp. gr.	1.0807	Quotient purity	88.68
Total Solids lbs. per gall.	2.193	Glucose ratio	*Nil!*
Glucose "	*Nil!*		

Vere.—Amity Hall Estate. *C. G. Muirhead, Esqr.*

Another year of deficient rainfall has been the fortune of this district and where no irrigation was available crops have been very poor. The ratoons from the last year's experimental plots with plant canes were again treated as before. The increased yield by manuring has been so small that losses occurred in all cases save two. It would appear that ratoons on this soil would respond profitably to a complete manure in a favourable season of growth. The results with the plants this year confirm the previous ones and indicate that manures are not required here for plant canes under present conditions. Lime has not

produced any marked effect; this was predicted from the analysis.

The difference in the crushing of ratoons and plants, 63 and 66 % respectively, is brought out in these results.

Thanks are due to the Hon. J. W. Mitchell and Mr Muirhead for their kind co-operation and to Mr. W. J. Thompson of the Agricultural Department for his servic s in recording the results.

Money Musk Estate suffered s verely from the drought and no data were obtainable that could be used for drawing conclusions. We sincerely hope that the cycle of dry seasons may give way to more favourable conditions for this important district in the near future.

Amity Hall.

Plots $\frac{1}{10}$th acre each. Feb., '03—March, '04.

Plots.	Description.	Tons per Acre. Canes.	Tops.	Total.	Increase.	Cost per Acre.
	Ratoons—					
1	No Manure	13.5	2	15.5	—	—
2	Complete "	11.25	2	13.25	−2.25	30/6
3	No Nitrogen	16.75	3 5	20.25	+3 25	15/5
4	Double "	20.75	3.5	24.25	+7.25	45/7
5	No Phosphate	16.	2.87	18.87	+2.25	21/5
6	Double Phosphate	15.	2.5	17.5	+1.5	39/7
7	No Potash	14.5	2.75	17.25	+1 .	24/2
8	Double Potash	11.5	1.75	13.25	−2	36/10
9	Double Comp.	17.5	3.5	21 0	+4	61/
10	Lime	14.	2	16.	+0.5	10/
	Average Manured Plots ...	15.25	2.7	17.95		
	Plants—					
1	No Manure	8	3.75	11.75	—	—
2	Complete	8	4 5	12.5	−1.87	38/2
3	No Nitrogen	8	4.5	2.5	−1.87	24/5
4	Double Nitrogen	8.75	4 5	13 25	−1.12	51/11
5	No Phosphates	10.25	4.5	14.75	+0.38	20/4
6	Double "	11	4.5	15.5	+1.13	56/
7	" Super	1[illegible].12	4.5	4.62	+0.25	53/
8	" Slag	9.5	4.5	14.00	−0.3.	38/6
9	No Potash	11	5.	16.00	+1.13	31/7
10	Double "	8 5	3.75	12.25	−1.37	14/9
11	Double Complete	9	4.	13 00	— .87	76/4
12	No Manure	11.75	4.75	16.5		
	Average no Manure	9 87	4 25	14 12		
	Average Manured Plots ...	9.41	4.42	13 83	·	

Ratoons:

Juice by estate mill	63 o/o
Brix	19.65
Sp. Gr. $\frac{30}{17\cdot5}$	1.0756
Sucrose lbs. per gal.	1.7264
Glucose "	.0624
Non-Sugars "	.2702
Quotient	83.84
Glucose ratio	3.62

Plants:

Juice by estate mill	65.9o/o
Brix	19.25
Sp. Gr.	1.0761
Sucrose, lbs. per gal.	1.69
Glucose "	.0952
Non-Sugars "	.2358
Quotient purity	81.64
Glucose ratio	5 62

Caymanas Estate.—St. Catherine.

The results with the ratoons at this estate are confusing and quite at variance with those obtained from the plant canes. The "No Manure" plot shows a marked increase over last year, despite a decided reduction in the general standard of production.

A fresh series of plots has now been started.

Caymanas Ratoons 12 months old, cut 31/3/04.
Plots $\frac{1}{5}$th of an Acre.

Plot.	Description.	Tons per Acre.			Increase	Cost
		Canes.	Tops.	Total.	Canes.	per Acre.
1	No Manure ...	25.75	6.12	31.87	—	—
2	Complete ...	23.5	8.75	32.25	—2.25	38/2
3	No Nitrogen ...	20.31	5.87	26.18	—5.44	24/5
4	Double Nitrogen ...	23.81	8.69	32.50	—1.94	51/11
5	No Phosphate ...	30.62	7.5	38.12	+4.87	20/4
6	Double Phosphate ...	21.25	3.12	24.37	—4.50	56/
7	Double Super. ...	23.06	11.87	34.93	—2.69	53/
8	Double Slag ...	23.62	11.25	34.87	—2.13	38/6
9	No Potash ...	18.25	9.87	28.12	—7.50	31/7
10	Double " ...	28.81	9.5	38.31	+3.06	44/9
11	Double Complete	23.37	6.56	29.93	−2.38	76/4

Juice extracted by estate mill	75 o/o	Glucose lbs. per gal.	.0435
Brix	19.20	Non-Sugars "	.2491
Specific gravity	1.0761	Quotient purity	85.87
Sucrose, lbs. per gal.	1.7784	Glucose ratio	2.44

Vale Royal.—Trelawny.

Returns from this district have again been reduced by unfavourable seasons.

While the manurial plots show a general increase, the cost has generally exceeded the value of the canes. The effect of Potash is clearly emphasized. The soil analysis indicated a low standard of available Potash.

It would appear that in an average year fertilisers should prove profitable.

Vale Royal 1903-1904. Ratoons nearly 13 *months old*, cut 26/4/04.

Plot.	Description.	Tons per Acre.			Increase, Tons Canes.	Cost of Manure.	
		Canes.	Tops.	Total.			
1	No Manure .	9.72	7.14	16.86	—	—	Plots $\frac{1}{10}$th acre.
2	Complete .	8.64	7.43	16.07	—0.1	38/2	
3	No Nitrogen .	11.40	8.17	19.57	+2.66	24/5	
4	Double " .	11.88	6.68	18.56	+3.14	51/11	
5	No Phosphate .	14.19	9.72	23.91	+5.45	20/4	
6	Double " .	13.43	10.42	23.85	+4.69	56/	
7	Double Super. .	11.67	8.32	19.99	+2.93	53/	
8	Double Slag .	12.17	7.60	19.77	+3.43	38/6	
9	No Potash .	9.72	7.77	17.49	+0.98	31/7	
10	Double " .	12.17	7.91	20.08	+3.43	44/9	
11	Double Complete	6.96	6.48	13.44	—1.78	76/4	
12	No Manure .	7.77	5.12	12.89	—	—	
Average	No Manure .	8.74	6.13	14.87	—	—	

Juice o/o extracted by mill	62 o/o	Glucose lbs. per gal.	.036
Brix corr.	19.57	Non-Sugars "	.206
Sp. gravity	1.0776	Quotient purity	86.17
Total Solids lbs. per gallon	2.112	Glucose ratio	4.72
Sucrose "	1.82		

THE EXPORTS OF JAMAICA IN RELATION TO THE SOIL.

By H. H. Cousins, M.A. (Oxon.), F.C.S., Island Chemist.

When the writer came out to Jamaica a few years ago, he was led to believe that the cultivated soils of the island had been seriously reduced in fertility by prolonged cropping under tropical conditions and that the problem of remedying this deficiency by the general use of fertilizers would form the chief subject of his investigations Typical soils from all the chief areas of cultivation have now been analysed and manurial experiments have been carried out on many types of land The general conclusions to be drawn from these preliminary results are (1) most of the Jamaica soils now in cultivation present a high standard of fertility on analysis (2) Fertilisers have only been productive of results on soils that have been under prolonged cultivation, and then only under favourable conditions of rainfall or of irrigation.

In the present article an attempt will be made to set forth the actual drain on the mineral elements of the soil fertility of Jamaica by the annual removal of Phosphoric Acid and Potash in the Exports of the island.

The last report of the Collector General gives an itemised account of the Exports for the five years 1899-1903. I have averaged these figures and taken them for the basis of a calculation as to the annual amount of Potash and of Phosphoric Acid sent away from the island in its Exports

Representative samples of 34 of the total number of 35 varieties of Exports scheduled were kindly obtained for the Department by Mr. Barclay, and the Potash and Phosphoric Acid therein has been determined. In the case of live animals an estimate based upon established data has been made.

The analyses are the work of Mr. H. S. Hammond, F.C S.

A table has been prepared showing the value and weight in pounds of each article of export, the percentage of Potash and of Phosphoric Acid, the Pounds of Potash and Phosphoric Acid and the value of these ingredients at current fertiliser rates reckoned as a percentage on the value of each article of export.

The Exports are ranged in the order of their financial value. Bananas leading with Sugar in the second place and Kola Nuts in the lowest position.

These figures show that our total Exports weigh 706,719,393lbs. (353,360 short tons) of a value of £1,806,4 .2. The average percentage of Potash amounts to 0 405 per cent. and of Phosphoric Acid to 0.126 per cent., with a total content of 2,865,522lbs. of Potash and 896,712lbs. of Phosphoric Acid. At current fertiliser rates the cost of importing these constituents into Jamaica would amount to £36,000 per annum equivalent to a rate of 1.95 per cent on the total value of the Exports.

Broadly charging this loss to the cultivated area of the island, which, for the period under review, is estimated at 700,000 acres, it would appear that our Exports, when assessed as an acreage charge, amount to *£2 11s. 6d* per acre in value of produce and at a charge of 4lbs. of Potash and 1¼lbs. of Phosphoric Acid to the soil, the cost of

restoring these to the land being approximately 1s. per acre. If we remember that an average soil in Jamaica to a depth of one foot contains 6,000lbs. of Potash and 4,000lbs of Phosphoric Acid per acre, it is apparent that the losses of soil fertility in our Exports are infinitesimal when referred to the island as a whole. There is chemical security for a tenfold increase in the quantity of our Exports without seriously trenching on the soil-reserves of Potash and of Phosphoric Acid. It is readily granted that these figures are generalisations and do not face the problem of the individual cultivator of Bananas or of Sugar Cane. It would be no solace to the Banana growers of St. Catherine or St. Mary to know that there was plenty of Potash or Phosphoric Acid in the soils of another parish when their cultivated soils were languishing for lack of these ingredients. Allowing for 300 full bunches from an acre of land, Bananas, as exported, would remove 67lbs. of Potash and 20lbs of Phosphoric Acid per acre. The majority of soils now growing Bananas do not appear to be lacking in a full supply of these ingredients. I have estimated that the reserve in the irrigated lands of St Catherine would suffice to produce full crops for 333 years and in St. Mary for 600 years, in so far as the Potash supply is concerned.

Except in certain special cases, the problems of the cultivator in Jamaica are not those of restoring the mineral elements removed by the crops taken from the soil but the maintenance of tilth, aëration and the organic matter in the soil.

Our Exports clearly make a very small demand on the essential mineral elements of soil fertility: *our agricultural problem is not a chemical but a cultural one.*

I have ventured to lay these figures and data before the agricultural public of Jamaica as a text upon which to preach a short lay-sermon. It is my belief that the whole future of our agricultural prosperity rests upon the recognition of certain facts and their practical consideration by the people of this island.

Axioms of Cultivation.

1. DRAINAGE. Until recently this has been the most neglected feature of cultivation in Jamaica.

(a) *irrigable lands* should not be watered until an efficient system for draining off the surplus water has been provided. Egypt has been changed from a ruined to a prosperous agricultural country by establishing a drainage system as a counterpart of the irrigation works. This is much needed in St. Catherine. A trunk drainage canal to the sea along the most favourable level should be cut to carry off the seepage from the irrigation area.

(b) *medium to stiff soils*

The Banana plant is the most eloquent "local instructor" obtainable if the grower but learns to read its silent lessons. The cultivation of Bananas has taught Jamaica more agriculture in the last ten years than a whole past century of cane cultivation. In large areas of the island the grade of fruit obtainable from the Bananas is directly determined by the drainage. The crumpled, confused and interlacing strata of fine, retentive soil which form large areas of our Banana lands absolutely demand drainage before any adequate returns are ob-

tainable. Even the sloping hills and dales of St. Mary, although apparently drained by nature are in reality as dependent upon artificial drainage as the flat lands. No one now attempts to drain a hillside other than by a carefully graded contour trench, and this means has worked wonders already.

HUMUS.

The condition, the kindliness and the productive capacity of our soils in Jamaica is mainly limited by the supply of organic matter or humus. Under moist, tropical conditions the rate of decay of humus is extraordinarily rapid. All our areas of high natural productive power exhibit conditions favouring a rapid loss of humus.

The African agriculture practised by the peasantry when left to their own sweet will with undefined areas of crown lands to draw upon is generally recognised to be most pernicious. By burning a piece of virgin land, they rob it of years of high agricultural condition through the loss of humus and the land soon becomes hungry and poor.

Lying at the root of the prosperity, comfort, morals and even religion of the people is the chemistry of humus as a predetermining factor.

Fire-stick cultivation on outlying lands is responsible for a great deal, both socially and morally as agriculturally.

A residential holding with a combination of live-stock and planting is the cure for many evils. Land is plentiful in Jamaica. Good farming involves an intensive cultivation of the better lands by the careful storage and use of all available sources of humus from the outlying and inferior lands.

To the Banana cultivator HUMUS represents the crux of the problem for maintaining the industry in Jamaica on a permanent basis. Green dressing, compost of waste vegetation, manure from the animals of the holding, all these must be carefully husbanded and every effort used to keep up the standard of humus in the soil.

TILLAGE.

The curse of Adam is upon us, even in the Tropics, and cultivation of the soil is necessary if crops are to be secured above the minimum and in the teeth of adverse conditions.

For the peasant, the Fork should be the chief implement of tillage. Many a small holder would do well to keep two steers and use a small plough and a light cultivator. The writer is of opinion that a small hop-shim to be drawn by one mule would prove a most efficient substitute for the "hoeing grass" which is the bugbear of most plantations in St. Mary.

MARL.

Some of the soils of Jamaica are singularly destitute of Carbonate of Lime. Many of the alluvial soils are seriously deficient in this respect: even the red soils above the limestone have in many cases lost nearly all their original store of Carbonate of Lime. Fortunately, marl is frequently to be had within a reasonable distance. On many soils marl would prove the most profitable manure that could be applied. About 5 tons per acre is required to produce an appreciable effect. It should be applied broadcast over the surface after the first deep cultivation—forking or ploughing—and should afterwards be worked in with hoes or cultivators.

THE ANNUAL EXPORTS OF JAMAICA

WITH THE CONTENT OF POTASH AND PHOSPHORIC ACID.

Average of 5 years (1899–1903).

Order.	Description.	Value £.	Lbs. weight.	Potash per cent.	Phosphoric Acid per cent.	Lbs. Potash.	Lbs. Phosphoric Acid.	Value of Potash and Phosphoric Acid. Crop Value=100.
1	Bananas ...	£ 730,147	440,823,465	0.522	0.15	2,301,098	661,235	3.83
2	Sugar ...	163,146	39,739,451	—	—	—	—	0.0
3	Coffee ...	148,940	10,993,584	0.170	0.09	18,689	9,894	0.17
4	Rum ...	133,662	13,723,711	—	—	—	—	0.0
5	Oranges ...	117,614	41,375,556	0.290	0.089	119,989	36,823	1 25
6	Pimento ...	116,615	10,965,625	0.873	0.013	95,730	1,425	0.83
7	Logwood ...	98,298	83,015,072	0.166	0.163	137,805	135,404	2.43
8	Cocoa ...	65,440	3,044,272	1.056	0.291	32,147	8,859	0.59
9	Coconuts ...	51,842	24 441,864	0.342	0.023	83,591	5,622	1.69
10	Ginger ...	50,857	2,518,062	0.720	0.293	18,130	7,378	0.46
11	Logwood Extract ...	24,830	4,793,600	—	—	—	—	0.00
12	Fustic ...	14,948	12,481,551	0.098	0.008	12,232	998	0.87

ANNUAL EXPORTS OF JAMAICA, *continued*.

Order.	Description.	Value £	Llbs. weight.	Potash, per cent.	Phosphoric Acid, per cent.	Lbs. Potash.	Lbs. Phosphoric Acid.	Value of Potash and Phosphoric Acid Crop Value=100.
13	Cigars ...	£ 13,962	37,267	3.36	0.511	1,252	190	0.10
14	Cattle ...	11,609	946,800	0.18	1.9	1,704	17,989	1.31
15	Honey ...	8,734	1,539,008	0.043	0.006	662	92	0.08
16	Grape Fruit ...	7,368	1,418,352	0.203	0.016	2,879	227	0.41
17	Beeswax ...	6,733	121,968	—	—	—	—	—
18	Lancewood Spars ...	6,651	4,796,736	0.132	0.089	6,332	4,269	1.43
19	Hides ...	5,761	278,788	0.170	0.105	474	292	0.12
20	Lime Juice ..	5,403	1,346,202	0.134	0.026	1,804	350	3.81
21	Goat Skins ...	4,323	61,983	0.379	0.206	235	128	0.07
22	Annatto ...	3,110	430,026	1.572	0.473	6,760	2,034	2.68
23	Leaf Tobacco ...	2,644	52,904	3.370	0.489	1,782	259	0. 5
24	Bitter Wood ...	2,585	3,779,955	0.168	0.052	6,350	1,966	3.05
25	Lignum Vitæ ...	2,334	1,638,694	0.332	0.029	5,440	328	2.43

ANNUAL EXPORTS OF JAMAICA, *continued.*

Order.	Description.	Value £.	Lbs. weight.	Potash. per cent.	Phosphoric Acid per cent.	Lbs. Potash.	Lbs. Phosphoric Acid.	Value of Potash and Phosphoric Acid. Crop Value=100.
		£						
26	Cigarettes ...	2,102	19,036	3.110	0.480	591	91	0.31
27	Pineapples ...	1,498	401,800	0.153	0.007	4,224	28	2.83
28	Yams ...	1,315	418,607	0.274	0.047	1,147	196	0.98
29	Ebony ..	1,030	974,400	0.038	0.008	370	78	0.41
30	Divi Divi ...	951	277,568	0.946	0.158	2,626	438	2.11
31	Walking Sticks ...	524	100,400	0.054	0.025	54	25	0.14
32	Limes ...	454	100,971	0.157	0.015	159	15	0.37
33	Sheep's Wool ...	404	27,988	3.998	0.168	1,119	47	2.85
34	Mangoes ...	390	33,030	0.230	0.044	76	15	0.22
35	Kola Nuts ...	183	11,097	0.688	0.155	76	17	0.49
	TOTAL ...	£1,806,412	706,719,393	0.405	0.126	2,865,522	896,712	1.95

ON THE BUDDING OF NUTMEGS.

By T. J. Harris, late Agricultural Instructor, Experiment Station, Hope Gardens.

In countries where the science of agriculture is most advanced, no practical fruit grower would plant out seedling trees, except, perhaps, with the ulterior intention of budding or grafting upon them; this is due to his knowledge of the fact that the seedlings have an inherent propensity to vary, and in addition to this is the possibility of the seed having been cross-fertilized with an inferior, or perhaps, wild variety; and further, a seedling takes much longer to produce its first crop than a grafted or budded tree. Now the nutmeg seedling has still another disadvantage: it not only takes some seven or ten years to yield its first crop, and may bear inferior nuts then, but there are ten chances to five that it will not bear at all! After years of weary waiting fifty per cent. of the trees in a plantation of seedling trees may prove to be male or non bearing trees.

The seedling nutmeg then is simply surrounded with uncertainty; and it is with a view to doing away with this uncertainty that experiments in budding have been conducted at Hope

Several years ago grafting by approach was successfully carried out but this method could not be taken up commercially on account of the scions continuing to grow in a somewhat horizontal direction in much the same way as they would have done had they been allowed to remain on, and as part of the old tree, instead of growing upright as a seedling does; they failed to grow into profitable trees.

It then became evident that some means must be found for utilizing the central stem of the tree as scion wood, since it and its buds always grow in a vertical direction; some trees were accordingly cut down to within 3 ft. of the ground and encouraged to sprout, and in a short time each had four or five stems growing vertically and producing horizontal (primary) branches in whorls of five up their entire length in just the same way as a coffee tree does when it is stumped down, though in this instance two primaries are produced at each node; each stem would have made a complete tree, and since there were buds on the main stem it was reasonable to suppose that the buds on the stems would grow into complete trees too The method employed was that described in the articles on the budding of Mangoes and Cocoa,* the only difference being that the whole of the bud is to be covered with waxed tape, that greater care is required in fitting the bud, and the least possible time should elapse between the cutting out of the bud and fitting it into the stock.

Within the last ten years nearly three-quarters of a million nutmeg seedlings have been distributed from Hope Gardens, and many will probably soon flower for the first time; as the male trees "declare" they should be marked for budding upon later, using as bud-wood the vertical shoots of a female tree that had previously been cut down, selecting a tree for this purpose that is known to yield nuts of first quality, 60–80 to the pound.

It would be well to remember, however, that about four per cent. of the trees in a plantation should be male trees to provide pollen for

*Bulletin of the Department of Agriculture, Jamaica, Nov. 1903, pp. 253–257.

fertilizing the female flowers; and these placed on the windward side of the nutmeg walk so that the pollen may be blown among the female trees. Old useless male trees may be cut down and the resultant shoots budded upon.

DISINFECTING COTTON SEED.

In Barbados *

With the view of preventing, as far as possible, the introduction of any cotton diseases with the selected seed to be distributed by the Imperial Department of Agriculture, it is proposed to have this seed carefully disinfected beforehand.

This disinfection will be carried on with a solution of corrosive sublimate in the proportion of 1 in 1,000: that is 1 lb. of corrosive sublimate dissolved in 100 gallons of water.

It has already been ascertained that this solution will have no injurious effect upon the germination of the seed, while it is confidently believed that it will effectually dispose of any germs of disease that may be attached to the seed.

The following is a brief summary of the results of experiments carried on at the Mycological Laboratory of the Imperial Department of Agriculture in determining the effect of steeping selected cotton seed in corrosive sublimate for one hour and then sowing immediately.

Strength of corrosive sublimate solution.	Time for which seeds were steeped.	Percentage of seeds germinated after 4 days.	Total percentage of seeds germinated (after 10 days.)
Water	1 hour	73	84
1 : 1,000	,,	58	89
1 : 750	,,	77	88
1 : 500	,,	60	83
1 : 250	,,	46	84

It will be seen that steeping cotton seeds in solutions of corrosive sublimate up to a strength of 1 in 250 has no effect on the total number of seeds germinated. The 1 : 250 solution, however, appears to have a slight retarding influence on the speed of germination.

A second series of experiments has been started, carried out exactly as above. In this series, in addition, one set of seeds has been steeped in a 1 : 100 solution of corrosive sublimate.

A third series. to test the effect of steeping the seeds, drying them, and then planting them at different times after drying, has also been started.

II†

It is mentioned above that a second series of experiments had been started. This was a duplicate of the first series, but in addition, the

* Agricultural News, Vol. III, p. 117.
† Agricultural News, Vol. III, p. 149.

effect of a 1 : 100 solution was tested. The results were as follows :—

Strength of corrosive sublimate solution.	Percentage of seeds germinated.
Water ...	76
1 : 1,000 ...	74
1 : 750 ...	83
1 : 500 ...	78
1 : 250 ...	81
1 : 100 ...	43

The 1 per cent. solution thus had a marked effect in reducing the percentage of seeds that germinated.

A third series was started to test the effect of steeping the seeds, drying them and then planting at different intervals. The seeds were all soaked in a 1 : 500 solution of corrosive sublimate for one hour, on March 23. The results were :—

A. Seeds planted immediately,
percentage of seeds germinated = 73

B. Seeds dried, planted April 6 (after 14 days),
percentage of seeds germinated = 65

C. Seeds dried, planted April 13 (after 21 days),
percentage of seeds germinated = 71

D. Seeds dried, planted April 20 (after 28 days),
percentage of seeds germinated = 72

It is evident, therefore that, so far as the effect on germination goes, it is immaterial whether the seeds be planted immediately after being steeped or dried and planted at any interval afterwards.

III. In St. Vincent.

Extract from a Report by the Mycologist, &c., to the Imperial Commissioner of Agriculture for the West Indies.

Imperial Department of Agriculture for the West Indies,
Barbados, May 17, 1904.

Sir,

I have the honour to submit herewith, a report on my recent visit to St Vincent

2. At the Cotton Factory I inspected the process adopted for sterilizing cotton seed as reported by Mr. Sands. The process ensures that the seeds are thoroughly wetted by the corrosive sublimate solution. The drying platform of the factory forms an excellent place for drying the seeds after they are drained. The whole of the seed has now been sterilized.

3 With regard to the swelling of the seed and the effect on germination, I found that the swelling was chiefly in the cracked and broken seeds. To make certain that the swelling did not indicate any loss in the germinating capacity, I asked Mr. Knowles to test the germination of samples of both treated and untreated seeds. Of the treated seeds, 89% and 90% germinated, of the untreated, 92%. It

is clear that the germinating power of the seed, as distributed, is very high. I have, &c.,

L. Lewton-Brain, Mycologist.

Sir D. Morris, K.C.M.G.,
Imperial Commissioner of Agriculture
for the West Indies.

IV.

Protective Treatment of Cotton Seed in Jamaica.

By H. H. Cousins, M.A., F.C.S., Island Chemist.

I attach a summary of Experiments carried out as directed by the Board of Agriculture.

1. They show that soaking the seed in Copper or Mercurial Solutions for 24 hours is injurious to germination.

2. Treatment for 3 to 6 hours causes a reduction of 8 to 10 per cent. in germination.

3. Neither Copper Sulphate at a strength of ½, ¾ or 1 per cent. or Corrosive at 1 per 1000 prevented the appearance of the disease on the seedlings. In fact the untreated lot had only 1 per cent. of diseased seedlings against 6 per cent. in the treated lots. *Colletotrichum* was identified on the seedlings.

4. *Conclusion.* It is of great importance to get seed from healthy stock, since the disease is clearly a difficult one to treat

Fungicides for Cotton Seed.

Experiments on Sea Island Cotton Seed, imported by the Board of Agriculture, treated with Copper Sulphate solutions and Corrosive Sublimate (1 in a 1,000 parts of water).

Five plants of each lot were planted out for further observation

Solution.	No. of hours seeds were soaked in solution.	Washed with water after treatment.		Neutralized with Lime water after treatment.	
		Seeds that germinated o/o	Plantlets that showed signs of disease. o/o	Seeds that germinated o/o	Plantlets that showed signs of disease. o/o
Copper Sulphate ½ o/o	3	80	5	79	1
	6	77	6	70	7
	24	49	7	53	5
Copper Sulphate ¾ o/o	3	73	5	71	8
	6	71	9	88	6
	24	51	16	70	5
Copper Sulphate 1 o/o	3	73	3	73	7
	6	78	6	70	7
	24	60	5	64	6
Corrosive Sublimate 1 : 1,000	6	74	6	.	.
	36	48	2	.	.
Not treated ...	...	Not treated 85	1	.	.

Treatment by Mr. Wortley. Seeds grown by Mr. T. J. Harris, at Hope.

THE TWENTIETH CENTURY BOTANY.

Extract from an Address* by Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, U.S. Department of Agriculture.

The experience of the old world in the matter of botanic gardens is such as would suggest caution in any attempt to emulate what has been accomplished there. Representative collections of living plants are highly important and valuable, but in bringing them together the fact should not be lost sight of that botany can in the future be advanced by giving more heed to the æsthetic side of the work than has been done in the past, that is, assuming that collections of living plants are for study and general educational effect, much of their value in both directions may be lost by adhering too closely to rigid systems. Collections meeting every requirement for study and having great value in a general educational way will probably be maintained in what is more likely to be a natural system. Such collections can, moreover, be maintained at much less expense than the stereotyped ones, and will do much to bring the science of botany home to large numbers of people who can appreciate a bit of lovely landscape, but can see nothing in the little plots and formal labels so suggestive of cemeteries In other words, it seems to me that the old idea of botanical collections with small groups of plants representing certain systems of botanical nomenclature. or certain systems of botanical grouping, will give place to natural gardens where may be grouped herbaceous, shrubby and other plants in such a way as to appeal to the mind through the eye. Unquestionably a much greater appreciation of botany and botanical work can be brought about by gardens of this kind, and it is believed that great encouragement will be made in the matter of their development at educational institutions wherever opportunity affords.

In morphology and physiology we shall expect to see more and more important problems worked out by experimental methods. Less attention will be given to the mere accumulation of facts without proper co-ordination. The value and importance of experimental morphology are already beginning to be realized; that is, experimental morphology from the standpoint of work on plants in their natural environment rather than under laboratory conditions. The same is true of physiology In the past our knowledge of plant physiology has been largely based on laboratory work and studies of one or more individual plants. From such data broad generalizations have been made, which, as time has shown, have in many cases been erroneous. In other words, it has been found unsafe and unreliable to base generalizations in the matter of the life processes of plants on laboratory experiments alone. The physiology of the future will undoubtedly pay more heed to the broader questions of plant life in their relation to environment and their adaptation in general to surrounding conditions. In other words, ecology in its broad sense is to be an important factor in the future study of plants. In the past we have had a school of scientific workers arise and endeavour to demonstrate that the growth of plants is controlled in large measure by the chemical pro-

*Science, II, 19; 1 Jan., 1904.

perties of the soil. More recently another school has developed in which the physical properties of the soil are pointed out as the chief factors in influencing life processes. Those who study plants themselves cannot accept such generalities. It is not safe. Future ecological studies will undoubtedly furnish much new light on the true relationships existing between plants and their environment. These questions must naturally receive a great deal of attention for the reason that many of the most important problems in agriculture, horticulture and forestry will be based upon them.

It is in pathology that we shall expect to see very important advances within the near future. This science is just on the threshold of its development. From the purely utilitarian standpoint it will be of vltal consequence, and everything in the nature of strengthening it will necessarily need to receive most careful thought. The pathology of the future will have its groundwork in physiology. Less and less attention will undoubtedly be given to the mere question of remedial measures, and more thought will be paid to the causes of plant diseases and the relation of environment to these causes. The highest type of pathological work, in other words, will be in the field of preventive measures, either by the correction of unfavourable conditions or by developing plants in such a way that they can meet conditions which are not favourable.

THE RELATIONS OF PLANTS TO BIRDS AND INSECTS.*

By Elizabeth G. Britton.

It may not have occurred to many of our readers to associate the movement for the preservation of our native plants with the work of the Audubon Association and the Entomological Department at Washington, but there is no question that much of the change in the number and habits of our native birds is due to the changes made by man in the extermination of the native plants on which they feed, and that many of the *insecticides* which are so largely in use in agricultural communities are made necessary by the destruction of the natural enemies of the insects, the birds, and that they in turn do much to drive the birds away. That the balance of life can not be disturbed in any given region without causing countless unforeseen changes is best illustrated by Darwin's story regarding the connection between the clover, bumble-bee, mice, cats and old maids. The cat has also become a strong disturbing factor in the extermination of our wild birds, and combined with the destruction of native trees, shrubs, and herbaceous plants, the surroundings of all our cities and towns will account in a great measure for their disappearance. Some of the worst insect pests are not natives here, and it takes some time for the native birds to learn to like them.

It has been found that when the Colorado beetle or potato-bug started on its progress eastward, it met with but little resistance until it reached the State of Iowa. Here, so the story is told, a farmer noticed that after anointing his potato vines with Paris green a number of rose-breasted grosbeaks lay dead on the ground in the morning.

* The Plant World, Vol. VII; No. 3, 1904.

He watched the birds and found that they were bolting the objectionable insects with avidity. The grosbeak was the pioneer, but as the years have gone by other eastern birds have conquered their distrust of the new food and relished it.

The latest observations relate to the cotton boll weevil, which it has been found the mocking-bird will eat. It seems likely but for the great diminution in the number of mocking-birds the Texas pest would never have gained a foothold, or that with more stringent laws for protecting them the great problem of the Southwest is solved. It is also probable that ground-feeding birds such as the grackles and pipilos would probably accomplish quite as much.

In 1896 the United States Government caused the food of the blue jay to be investigated. It was found that three-fourths of its food consists of vegetable matter and that the remainder was composed mostly of insects. It was found that they ate insects every month in the year, the percentage varying from one in January to sixty-six in August, and that large numbers of grasshoppers, crickets, and locusts, as well as the caterpillars of the brown-tail and gypsy moths, are destroyed by them.

There is no question that bushes and trees producing juicy edible fruits are very attractive to birds, and that robins, thrushes, and king-birds frequent the wild cherry, elder, dogwood, tupelo, and viburnum, and the tangles of blackberries as long as there is any fruit to be found. In the fall the goldfinch may be looked for in the woody tangles of composites among the golden-rods and asters and the chickadees on the sweet-gums and other native trees in the winter We cannot expect the native birds to remain with us if we destroy all the native plants and in place of their favourite food and nesting places give them cultivated trees and shrubs and smooth grassy lawns! It makes very little difference to the birds what man does if he does not disturb them and leaves enough food and shelter. They will nest close to a railroad track with hundreds of trains thundering past, or settle in the midst of factories and overhead traffic, like the wild duck in the Genesee River at Rochester—if only the proper food and shelter is at hand.

PLANT WOUNDS AND NATURAL PRUNING.*

By C. E. Waters.

Perhaps we do not always remember, when we go into the woods, that the trees with tall clean trunks, were not always so smooth and lofty, but started as small plants with branches near the ground. How is it, then, that there is so little evidence of those old branches when they grow larger? The tree must be able in some way or other, to get rid of them without injury to itself. This requires breaking the branches in some way, in spite of the fact that perhaps the greatest danger to which a plant or animal can be exposed, is a wound by means of which bacteria may enter and cause blood poisoning or decay, as the case may be. Every healthy organism, whether plant or animal, is able to resist such attacks for some time, which is not a bad thing for the bacteria, as otherwise it would be like the bear living by

* The Plant World, Vol. VII, No. 3, 1904.

sucking its own paws—there would soon be nothing but bacteria left to feed upon one another In our own bodies we have the white blood-corpuscles whose function it is to destroy any bacteria that may find an entrance into the blood. In some diseases infected spots are shut off from the rest of the body by layers of resistant tissue that keep the "germs" from getting into the general circulation, and in time causes their destruction from lack of food. Plants do not have white corpuscles, but it is certain that they have some means of resisting such attacks.

Perhaps the simplest way of keeping out bacteria would be the drying of the tissues around the wound, and we find that this takes place frequently. The hard, dry cell walls do not easily yield nourishment to the "germs," as we know from the length of time seasoned timber lasts. Cellulose, which is the principal constituent of the cell walls, is closely related to sugar, starch, glucose and a number of gums, but it is much more resistant to the action of chemicals, and digestive fluids do not readily dissolve it. When the wood is fresh there is a greater chance that the cellulose may be eaten away. After drying it resists the attacks long enough to give the plant an opportunity to strengthen its defences. Among many cryptogamous plants this is the sole method of protection, while only a few phanerogams depend on it alone As a rule, they produce a layer of "wound-cork" that cuts off the injured spot from the underlying parts of the stem. This is nearly a complete cure in the case of the more tender parts. Woody stems form a "callus" by the growth of the surrounding cells that afterwards form a corky layer. The new wood gradually spreads over the wound until the edges meet and coalesce. Outwardly it seems as if there had been no harm done, but the injured cells inside remain brown and dead, and can be seen until the decay of the tree, by cutting into the wood.

When a thin section of the "wound-wood" is examined under the microscope it is seen to be made up of nearly cubical cells that are quite unlike the usual elongated cells of normal wood. As the tree increases in diameter these wound cells become more and more like those of injured wood.

Many plants possess strongly-smelling "ethereal oils" that play a part in warding off enemies that might otherwise use them for food. These substances are often contained in special glands or receptacles. The different gums and resins occur in similar canals and receptacles throughout the plant. One of their principal uses seems to be to flow out and cover up wounds, and in this way to prevent the entrance of injurious fungi or bacteria. Cherry tree gum is familiar to all, and the resin on pines and the related trees will keep away almost anything, including bacteria, but a small boy with climbing proclivities.

Most of the information here given was obtained from Strasburger's "Lehrbuch der Botanik," but the subject was suggested by seeing some peculiar lumps on the trunks of the beeches. There seemed to be no especial reason for their presence until it was noticed that nearly every one had either a dead twig protruding from it or showed some sign to indicate that one had been there. It is evident that a dead branch is in reality a serious kind of a wound, for the decaying wood is in such close connection with the main stem that there is great danger of the infection being communicated to the whole plant. When

the dead branch breaks off close to the trunk the problem is practically the same as when the bark is injured, and new wood is formed around and over the stump and finally encloses it, Many of the "knots" seen in lumber are simply these old branches that were enclosed in this way. They are darker than the surrounding wood because they were exposed and had begun to decay. The lumps on the beeches showed what efforts the trees were making to cover the tiny dead branches. In some cases they were so successful that there was nothing on the surface to show that a twig was underneath. But when they were cut open it was all plain enough, and a little search revealed all stages, from twigs not yet buried to those with the tip still showing and then the final step when all trace was gone. In the course of time the knobs disappear, and there is nothing to show that they had ever been there, except when we cut into the wood and see the "knot."

The beech is a tree whose branches are very responsive to light. One close in to the trunk will often grow only a small fraction of an inch each year, while another at the end of a prominent branch in the full sunlight may grow a foot or more in the same time.. The winter bud-scales of the beech leave ring-like marks around the twig when they fall off, and by these we can tell the age of the branch. They are most conspicuous on the under side of the twig for they seem to appear sooner on the upper side, probably on account of the slightly more rapid growth there. Occasionally a twig scarcely a span in length will represent the growth of a quarter of a century, but this does not give a correct idea of the age of the tree, because most of the growth of the latter is at the top where it has enough light. No doubt the twig started to grow when the tree was quite small, and it would be of interest to cut into the trunk of some dead tree to see just how far we can trace the branch The main point, however, is that it is in an unfavourable situation, and in time succumbs, and at last breaks off. When the stump is short the tree has little difficulty in protecting the wound in the way described. The longer stumps are the cause of the formation of the lumps seen here and there.

The beech is not the only tree that gets rid of its superfluous branches, though we do not often see trees with such knobs as we have described. When a tree grows in the open it may have low branches in a healthy condition but wherever they are crowded together the lower ones die. They are unable to receive enough light, and the upper ones do the work for the entire tree. As fast as they die and drop off, the scar is covered as we have seen. Failure to do this properly and soon enough, results in permanent injury, and the decayed portion spreads down through the trunk, giving in time a hollow.

THE BREADFRUIT.*

By Henry E. Baum.

The breadfruit tree has for over a century occupied a unique position in the vegetable kingdom. Its farinaceous fruit serves the Pacific Islanders in lieu of the wheaten loaf of the western hemisphere,

*Reprinted from *The Plant World*, VI., 197: Sep., 1903.

and along with the taro, yam and banana furnishes the daily food of Oceanica. When the pioneer Europeans in the Pacific began to find cluster after cluster of tropical islands full of new things of ethnological and biological interest, nothing more worthy of mention was seen than this new fruit,or rather vegetable, which was produced in abundance practically all the year with no cultural effort on the part of the native beyond the original planting. From the time of its earliest authenticated mention it became an object of curiosity and inquiry, until as an indirect result of Captain Cook's splendid efforts between 1769 and 1777 in charting the unknown ocean, an expedition was sent out by the English crown to obtain this valuable food-staple for His Majesty's most loyal West Indian subjects. The mutiny of the *Bounty*, with the subsequent founding of the Utopian community on Pitcairn's Island by the reformed mutineer Adams, was the result of this first attempt at introduction into the American tropics; but success was spelled a few years later when Bligh, who also commanded the former expedition, made the trip safely from Tahiti in the Society Islands to St. Vincent and Jamaica in the West Indies, with a cargo of the precious trees. The existence of a record of a still earlier, but half-forgotten, introduction of the seeded fruit into the West Indies through a captured French vessel, and a knowledge of the fact that the fruit failed completely to meet expectations as a source of food supply in it new home, renders its history fascinating; and this interest is still further strengthened when we reflect that it has not yet reached its decline, but has a potential future as a food plant in our newly-acquired tropical islands, in which it has never been properly exploited or appreciated.

BOTANICAL DESCRIPTION.

The breadfruit tree (*Artocarpus communis*) is botanically a member of the mulberry family (*Moraceæ*), and is related to the Central American rubber tree (*Castilla elastica*) and to the common osage orange (*Toxylon pomiferum*) of temperate regions. The large tropical genus Ficus, which includes the fig of commerce, is also not far removed from it in botanical relationship. The tree attains a height of from 30 to 60 feet, according to soil and climate, having a diameter ranging from one to three feet. The straight trunk, with its rough yellowish or grayish bark, rises clear from the ground for 10 or 15 feet before the first wide-spreading horizontal branches are met with; the top of the tree is spreading, in general outline roughly cone-shaped, the lower branches being the longest. The tree furnishes a good shade, which is sometimes utilized in coffee and cacao plantations as well as in gardens and about houses. The limbs are, however, too easily broken by the wind to make it a good plantation shade tree.

The leaves are large, alternate, and vary in size and shape on the same as well as on different trees. The size ranges from a foot to 2 or even 3 feet in length, and from 10 to 18 or more inches in width; in outline they are ovate, cuneate and entire at base, but with the upper part pinnately cleft into 6-12 more or less deep, rounded incisions.

The fruits are borne on solitary peduncles produced from the axils of the leaves near the ends of the branches. The buds are included within the same enveloping leaf. The male flowers are densely packed

on a cylindrical or club-shaped fleshy catkin from 8 to 16 inches in length yellowish in colour, while the female flowers are grouped around a globular, fleshy receptacle, developing into a fruit morphologically analogous to the mulberry or strawberry and resembling in some varieties a greatly magnified sycamore seed-ball: two or three sometimes grow closely bunched. The shape, size, and markings of the fruits differ greatly, some weighing but one or two pounds, others as much as eight or ten pounds, and varying from 6 to 18 inches in diameter. In some of the seeded varieties portions of the stigmas remain attached to the mature ovaries, the fruit consequently presenting a muricate appearance, while in the seedless sorts the surface is almost smooth, being marked with hexagonal areolae. The peduncles, petioles, and fleshy parts of the branches are all covered with very short, fine hair, harsh to the touch.

VARIETIES.

All breadfruits fall under one of two great varietal heads according as they do or do not mature seeds. Through long-continued cultivation a portion of the trees began to produce abortive seeds and to depend more and more upon human agency for the perpetuation of their kind, until the seedless sort was evolved. This variety is propagated by suckers from the roots, which are not especially hardy and require average care in transplanting, but with the usual agricultural skill displayed by the Polynesians were taken from group to group in the Pacific until the whole oceanic archipelago was occupied. In their new home the differentiation went on, until in some of the islands there are as many as twenty-five recognised local varieties.* While there can be no doubt but that some of these are identical with varieties in other groups, there is, nevertheless, no way of getting a tentative descriptive list until they are grown together or a ge eral survey made.

The seeded breadfruit is almost entirely propagated by means of seeds, while the seedless or abortive sort is perpetuated by suckers from the roots, by branch and root cuttings, by various modifications of the process of layering, and by grafting.

RUBBER-PRODUCING QUALITIES.

The whitish viscid juice in which this tree, like all its relatives, abounds, is not the least important of its products, meeting with ready and constant use in the islands of the Pacific as a pitch and bird lime. The natives of Br..zil, to whom the tree was unknown a hundred and fifty years ago, use its latex as a bird lime and a substitute for glue, it being entered in fact in Pearson's work on rubber substances under the name of "Brazilian bird lime." It is, however, in the South Seas that it becomes of actual economic importance, being about the only available gum for caulking the seams of canoes, which are in most cases not mere dugouts, but boats cunningly constructed from pieces of wood 18 inches to 5 feet in length and usually sewn together with the fibre prepared from the husk of the coconut.

In most lists of rubber-producing plants one member, at least, of the genus Artocarpus is generally given, and the breadfruit itself has been

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* Christian records twenty-five varieties of the sterile breadfruit from Ponape in Caroline Island. (Christian, F.W. "The Caroline Islands." London, 1899.)

placed in this category. While it is certainly true that every part of the tree, even including the fruit until complete maturity is reached, abounds in a viscid milk easily obtainable by tapping, it is, however, extremely doubtful whether rubber of requisite quality and in quantities needed for commercial exploitation can be extracted. Like our milkweed and osage-orange, this tree no doubt contains a rubber-like principle which will appear after a reasonable amount of coaxing and a considerable expenditure of time, but after all scarcely worth the search. Mr. R. H. Biffin, who has examined the phenomena of coagulation in the latices of a number of plants, obtained the following results with that of the breadfruit.

"When diluted and centrifugalized it separates readily, giving a creamy white layer which dries to a resinous mass somewhat resembling gutta-percha. At the ordinary temperature this is quite hard and brittle, but if the temperature is raised slightly it becomes plastic, and at the temperature of boiling water it is soft and excessively sticky. The substance is soluble in carbon bi-sulphide, and insoluble in water and alcohol."*

From this it becomes apparent that unless superior methods of extraction and treatment for its gum are found, the breadfruit will scarcely enter into competition with any of the commercial rubbers. Experiments recorded by Watt with the milk of the jak (*A. integrifolia*) were, however, more promising in that the rubber prepared from its gum was leathery, waterproof, and capable of removing pencil marks, thus fulfilling at least the requirement which gave rubber its name.

The breadfruit trees throughout Porto Rico are scarred with machete marks made by the natives for the purpose of obtaining milk, which they boil with coconut oil to obtain the thick, gummy substance used in caulking canoes and rendering bottles water-tight; this is also used as a birdlime before it hardens. The milk is used as a medium for paint in the Pacific Islands, serving its purpose well, although for interiors it does not give as smooth a finish as paint prepared with oil.

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*Kew Bull. 140. pp. 177–181. August, 1898.

(To be continued.)

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. JULY, 1904. Part 7.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

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Hope Gardens.

1904.

JAMAICA.

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Vol. II. JULY, 1904. Part 7.

SCHOOL GARDENS.

By T. J. Harris, late Agricultural Instructor, Hope Gardens.

Most elementary school teachers in Jamaica are aware that a school garden is maintained primarily for the purpose of affording material for the lessons in nature study and elementary science given to the school children; few, however, have realized the importance of such work, even though they know that the prosperity of the country depends entirely upon the skill and energy evinced by the agriculturist and these again upon the amount of enlightened interest taken in the common phenomena of every day life both as regards plants and animals.

It must be remembered by the teacher that the conditions that obtain in Jamaica are very different from those of Britain, America and the European continent, where, in the large towns, hundreds of boys and girls attend one large school, who are not expected to go to the land but are trained with a view to making useful men for the great factories and workshops, and thoroughly domesticated women for the myriads of little homes. It is the country lad who goes on to the land, who makes the most successful farmer. Compare his youthful experience with that of the town lad; the country boy on his journey to and from school is daily confronted with varying phenomena of bird, animal, plant and insect life, and on arrival home in the evening has accumulated numberless questions with which to bombard his parents; who are invariably careful enough to answer the questions correctly and to encourage the lad to ask more.

The poor town lad sees nothing of the beautiful and wonderful objects of nature, he sees nothing but huge factories and warehouses, bricks and mortar, pavements and traffic; little wonder that he becomes more and more a machine when later we find him carrying our his life's work amidst the deafening roar of machinery.

It may be argued that the country-side boy of Jamaica has the same or equivalent advantageous surroundings as the northern boy; this is

so to some extent, but he, as a rule, lacks the enlightened and sympathetic parents and the daily sight of neatly laid out gardens and plantations.

Now cannot the teacher fill this crying want? How many are ready, willing, anxious to minister to the spiritual needs of the community; why not to the material? nay, this also is spiritual! No one is in closer touch with God's work than the agriculturist, our great naturalists were and are most godly men, and a late Archbishop of Canterbury was a profound student of Nature.

The first work to be undertaken by the elementary school teacher is to lay out a garden in such a way as to permit of all the crops planted therein being neatly arranged in straight lines; to effect this a regular systematic plan should be followed; accompanying this note is a plan of a quarter of an acre garden suitable for a school in which it will be seen that the whole garden is an exact rectangle with an intersecting main path down the centre and side paths leading from it to the garden fence to permit of inspection without trampling on the plots.

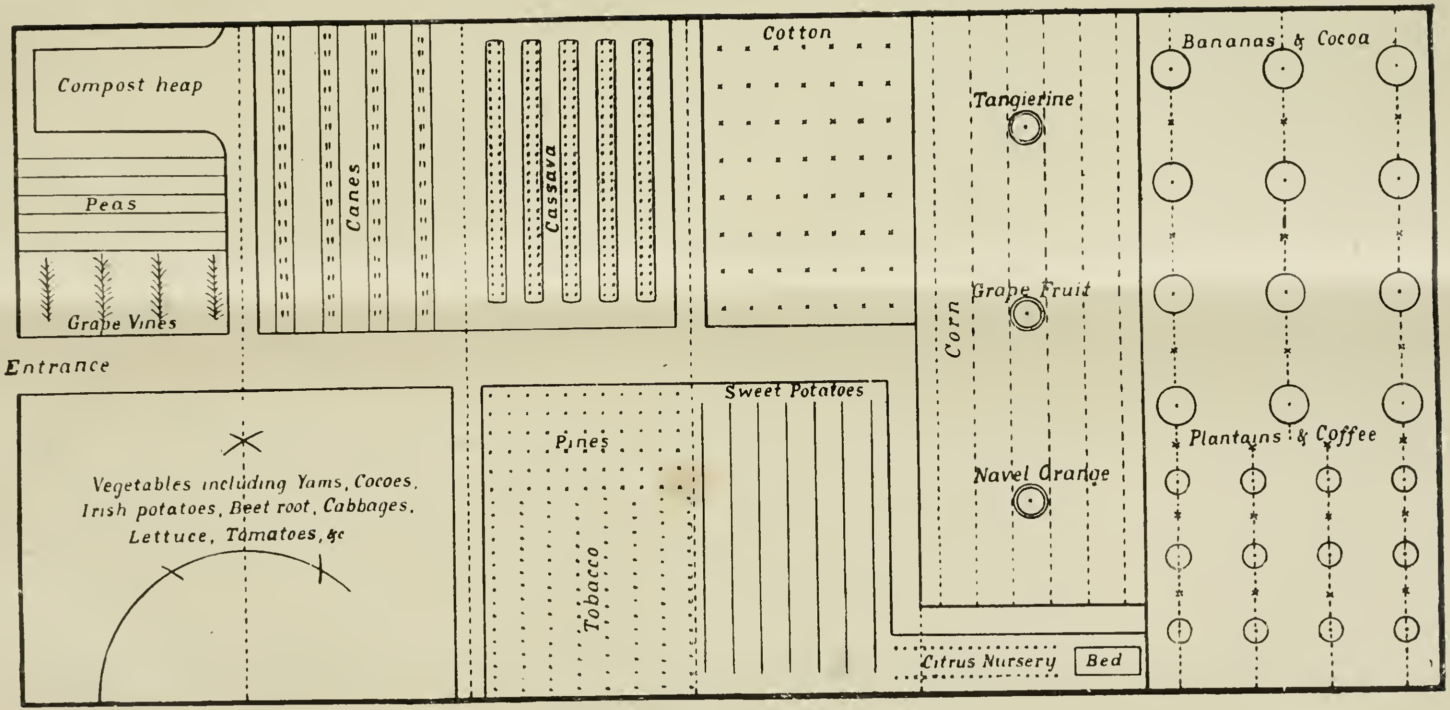
The width of the main path is 6 ft., of the side paths 3 ft., and the five sections (1), (2), (3), (4), (5), 24 ft. wide each (see dotted lines); section No. 6 is $31\frac{1}{4}$ ft. wide, making each side $151\frac{1}{4}$ ft. long; the width of the garden therefore, being 72 ft., will make:—$151\frac{1}{4}' \times 72' = 10{,}890$ sq. ft. $=1{,}210$ sq yds. $=1$ quarter of an acre. For a smaller garden, say one-half the size, ($\frac{1}{8}$th acre), the same plan may be used, but the scale of course, must be changed,

Having lined out the plots and paths, the temporary pegs which mark the sections should be replaced with permanent ones of hard wood to serve as points from which to measure when lining out for planting the various crops; the surface soil of the paths should then be removed to the depth of 4 to 6 inches and scattered over the adjacent plots, stones or shells laid along the edge of the plots, and the path filled with gravel or sand. It is highly important that the children be allowed to assist in the laying out of the paths and plots, and if the teacher is careful to get correct right-angles and parallels and exact measurements, he will not fail to enlist the interest of the children.

The work of planting may now commence, each section to be taken separately, beginning, say, with No. 6; reference to the plan will show this to contain bananas interplanted with cocoa, and plantains with coffee; the bananas are 12ft. apart and the plantains 8ft. The cocoa and coffee trees are not planted until the bananas and plantains are large enough to give sufficient shade. The lining out should be done as carefully as possible; a glance at the plan will suggest the method to be employed.

The citrus section may be taken next, planting corn, when the proper season arrives, along the lines marked. The nursery will consist of a small seed and nursery bed, and later two rows of stocks set out for budding upon.

A careful study of the plan will render instructions as to the remaining sections superfluous; it must be understood, however, that this plan is more suggestive than imperative; numberless difficulties will beset the teacher, but it is felt that these brief instructions will be found useful when the work is taken up in real earnest.



PLAN OF SCHOOL GARDEN.

A record should be kept of all the sowings, plantings, &c. of the various crops, giving a section of the book to each.

The teacher should endeavour to become acquainted with the animal, bird, and insect life of his neighbourhood and encourage the children to ask questions about these and the wild plants and trees of the district; pointing out on every available occasion the various items of interest that present themselves.

Every teacher should be in possession of a copy of "Nature Teaching," by Hon Francis Watts, F.S.C., F.C.S., to be obtained at the Educational Supply Co., Kingston.

ARBOR DAY.

(1)

We* hope and we think that the offer of the Director of Public Gardens to supply seedlings in bamboo pots of certain trees that he names in the list we published on Monday, to any church, school or private individual prepared to plant them out on Victoria or Empire Day, the 24th of next month, will be largely accepted in all parts of the island. The offer includes the sending of the plants to the Parade Gardens, Kingston, or to any railway station, if applicants will state the number required. If sent by coastal steamer the cost of freight will be charged. Applications will be attended to in the order of applications, but none can be attended to if received later than 13th May. If the applications, as we hope, are to be numerous, there will be trouble and disappointment among the dilatory people who from habit put off applications to the last moment. The plants should all be at their destinations days before the 24th and the 23rd should see the arrangements for planting complete. Last year His Excellency the Governor and the Education Department expressed the hope that Empire or Victoria Day might be suitably observed by the schools. but the notice came too late to have much effect. This year we expect that a good deal will be done to keep step with the larger colonies in teaching the children to "think imperially," by exercises such as Lord Meath and others have been encouraging both in the United Kingdom and abroad on the 24th of May.

If the teachers take up the matter zealously, they will make the celebration a success. None know so well, as one of them has said, the value of name days and catch words. "Children possess an inherent love of the ideal and the noble, only needing something intelligible to their child-nature to draw it forth. They have also an instinctive longing for ceremony, so that by its means deep principles may be readily impressed, and that, in the majority of cases, lastingly." If the managers join with the teachers, the celebration will be enthusiastically and well carried through Loyal and patriotic songs, recitations, and readings it will not be difficult to find. These properly prepared and arranged, with parents and friends of the children present to cheer them on, will make the day a bright and memorable one. The processsion to the spot, previously prepared for the planting of the seedling or seedlings with appropriate exercises will heighten the interest of the young people Sir Daniel Morris has been doing

* Reprinted from "Gleaner." 21st April, 1904.

much in other West Indian Colonies successfully to popularise tree-planting for aesthetic, economic, and memorial purposes. He holds that the systematic planting of ornamental and shade trees under suitable auspices would greatly tend to advance the social and public interests of the West Indian colonies. It would instil, he says into the minds of the rising generation the almost sacred duty of trying to leave the world a little better than they find it. It would familiarise them with the needs and requirements of plant life and infuse a spirit of regard and affection for trees, and check the almost universal desire, now existing, to cut down and destroy, rather than cherish, what might become useful and ornamental. He further adds that the systematic care and attention to detail called forth by the planting and nurture of even one tree and watching its growth and development could not fail to have a formative effect on character, and would have a high education value in cultivating the love of Nature and the observation and interpretation of her wonderful laws.

No doubt there will be some tree-planting by Sir Augustus Hemming on May 24th, not only because he leaves the island so soon thereafter, but also as a memorial of the time he has spent here and his desire to foster the imperial spirit which Empire Day embodies. The Training Colleges have a part to do as leaders of the schools and as centres from which young men and women go out who are to carry the loyal spirit into the locality in which they are afterwards to labour. Where there are two or three schools, as in Brown's Town, a united procession and celebration would add much to the interest and the profitableness of the day. There is not only the school yard to beautify, there is the plot of land around the school manager's house and the teacher's cottage where there is one to provide for, and there are spots in every town where ornamental and shade trees might be placed, whether in public or private grounds, that would please the eye and promote health, if the needful protection can be secured. The recent death of the teacher of Mearnsville school, Westmoreland, called forth a general expression of regret in the locality that showed how highly he had been esteemed. In such a case a memorial tree, planted by the school children would do them good, and would be kindly cared for. We mention the case as a sample of what might be done in many places with much advantage. In framing a programme for a tree-planting day there is the whole of the poetry of thought feeling, life, action to draw from—the poetry of Nature in her many moods. If managers and teachers do their part well, the schools will hail the day with pleasure and keep the anniversary with enthusiasm.

(2)

By W. Fawcett, Editor of the Bulletin.

Almost* every English-speaking country now celebrates an Arbor Day—a general holiday specially devoted to the purpose of planting trees.

The custom arose in the plains of Nebraska where the general absence of trees was a powerful factor in inducing the people to accept the suggestion of an annual holiday for the observance of an Arbor

* Reprinted from the "Gleaner," 21st May, 1904

Day The first Arbor Day was the 22nd April, 1872, and from that date to 1896—twenty four years—it was computed that 605,000,000 trees were planted in Nebraska alone as the result of this popular movement. Other States followed, and the custom spread to Canada, England, Australia, New Zealand, South Africa.

Our late beloved Queen delighted to plant a tree wherever she went, as a memorial of a visit, and no better day could be chosen than her birthday for the observance of Arbor Day.

The Americans are eminently practical, and it is not probable that Arbor Day would have become so universally observed, if the advantages, both to the individual and to the State, were not so evident to every thoughtful mind.

Compare a country or a district naked of trees, except for a few scattered solitary individuals, with another country well clothed with a lace-like garment of trees. The contrast may often be seen in a day's journey by train in America. Where there are few trees, the fields are seen to be washed of their soil by rain, which sweeps over them without check, swelling the turbid streams and rivers beyond their natural bounds, and causing destruction to banks, bridges and dwellings. Where the clothing of trees makes the landscape a perpetual delight, the rain impeded in its flow, sinks to form wells and springs, the stream show no sign of wasted fertility, there is shade for man and beast, orchards of fruit trees, and abundance of timber for home use and for export.

Moreover, where the education of the masses is considered to be the first duty of the statesman and the philanthropist, the value of trees in a scheme of nature study is well understood, and the lessons that can be learnt from trees by the young are perhaps the highest inducement to plant them. The beauty of trees, the mystery of their unfolding buds, the changing colours of the leaves, the distinct character of the branching, the grace of their pose,—if pointed out with sympathetic expression—can hardly fail to inspire a love of Nature in the mind, which will remain forever a source of pure delight. Besides the aesthetic side there is also the practical;—there is growth according to definite laws which can be ascertained by observation and experiment, growth which can be assisted by systematic care and by constant attention to details.

The mere planting of a tree may be an interesting ceremony, but it will do more harm than good if it is not followed up by daily care. It will only emphasise that thoughtlessness and carelessness which are but too prevalent amongst our people, who are too apt to think that a plant may be stuck into the ground anyhow and then left to nature; that it is the fault of the plant or of some one else if it does not thrive without water, without forking, and without manure; that anyway, after the excitement is over, it is too much bother and trouble to pay any further attention to it. Unless people are prepared to go to a considerable amount of personal trouble over the trees that they propose to plant on Arbor Day, it would be better that they should not plant at all. The lessons to be learnt will be lost, and bad habits will only be confirmed.

(3)

Applications for plants for Arbor Day were received up to the 13th of May from all parts of the island. These were attended to in rota-

tion as received, and the various lots were despatched in good time. In all 448 applications were received, and 6,870 plants were supplied. Many applicants asked for plants such as grafted nutmegs and choice fruits that were never intended for free distribution, and others asked for many hundreds of plants of various kinds; but the kinds and numbers sent to each applicant had to be carefully considered, so that all should be able to participate, and that there should be no suggestion of favouritism.

The selecting, naming, packing and despatching of these plants at short notice caused a great deal of extra work and considerable expense, and it is hoped that this effort to encourage the planting of trees will be appreciated, and will have a good effect.

The following list shows the number of plants sent out:—

Breadnut	197	Kola-nut	661
Cananga odorata	288	Lignum Vitae	929
Carapa guianensis	52	Mahoe	389
Cassia Fistula	180	Mahogany	485
Cassia grandis	3	Melaleuca	41
Cassia siamea	89	Moringa	411
Dillenia indica	89	Palms	713
Diospyros discolor	29	Poinciana regia	5
Divi-divi	59	Sand-box	140
Dolichandrone tomentosa	72	Savannah Oak	5
Ebony	13	Spathodea	230
E. Indian Mango	12	Sterculia Carthagenensis	4
Erythrina	13	Tamarind	12
Eucalyptus	638	Triplaris americana	24
Ficus	7	West Indian Cedar	125
Grevillea robusta	121	Wild Tamarind	50
Java Almond	96	Yacca	4
Juniper Cedar	175	Miscellaneous	1,6[illegible]9
		Total	6,870

THE SUGAR EXPERIMENT SCHEME FOR JAMAICA.

At a meeting of the Privy Council held on the 17th May, 1904, the Governor in Privy Council sanctioned the application by the Board of Agriculture of the sum of £10,000 and the proceeds thereof under the provisions of Law 45 of 1903, in the manner below set forth for the establishment and maintenance of a Sugar Experiment station, experimental cane cultivation, experiments by a Fermentation Chemist, technical and scientific instruction in connection with the sugar industry and other cognate objects in connection with the sugar industry.

ESTIMATES FOR SUGAR EXPERIMENT SCHEME UNDER LAW 45 OF 1903.

Imperial Grant ...		£10,000
Summary—Capital Expenditure	£3,000	
Maintenance at £1,400 per annum for 6 years with accrued interest	7,000	10,000

Capital Expenditure—		
1. Sugar Laboratory, Fermentation Laboratory, Building, fittings and appliances		£1,000
2. Experimental Distillery Temporary Building, boiler, engine, small mill, vessels, experimental still, adjustable, 50 gallons		1,000
3. Alterations and new plant for Estate Distilleries		1,000
		£3,000
Annual Expenditure—		
Personal Emoluments:—		
Fermentation Chemist		£300
Assistant to Chemist		70
Superintendent of Field Experiments		150
3 Assistants at 15s. per week		117
Total Personal Emoluments		£637
Other Charges—		
Reimbursement of Travelling Expenses:—		
Fermentation Chemist		£50
Field Superintendent		100
Chemicals and apparatus		100
Manures for experiments		60
Distillery expenses—		
Distiller	£30	
Day Labour	30	60
Distillery material from Estates		50
Repairs and new plant		30
Cane cultivation at Hope—		
Grant in aid of canes		50
Education—Training of distillers, 10 at £10 each		100
Printing, contingencies and unforseen		63
		£1,400

The following explanatory minute by the Island Chemist is published for general information:—

GENERAL PLAN OF OPERATIONS,

Sugar Experiments in Jamaica.

It is possible to talk of the sugar industry of Barbados or of Demerara, but this is not the case with Jamaica. There are six different sugar industries in Jamaica, and it is impossible to generalise or to accept any single centre as representative of the other five. At first sight it might seem desirable to equip a sugar experiment station in one of these sugar districts on which all the experiments in manuring, selection of improved canes and the investigation of sugar and rum manufacture might be carried out. A careful study of the great variations in the agricultural and other conditions represented by the

Sugar Estates of the Island clearly demonstrates the desirability of carrying out the experiments locally under actually existing conditions of estate management. To secure the scientific and technical control of these local experiments a Central Laboratory and research station is necessary.

The following plan of operation has therefore been laid down.

Local Experiments.

Manuring of Canes.—Results already obtained show that considerable agricultural returns can be obtained in the cultivation of canes by the use of lime or marl on soils not deficient in humus and nitrogen, by the judicious use of fertilisers where the water supply enables large crops to be grown with some certainty and lastly of the great effect of drainage upon stiff flat areas of land.

It is proposed to extend these experiments, to carry them out with stricter over-sight and control and to aim at the financial demonstration of the results of the operations under test.

Seedling Canes.—There are districts in the island where the seedling canes already at our disposal are capable of giving a return of at least 30 per cent more sugar per acre than the Jamaica cane. The seasonable and irrigable areas should benefit with certainty from carefully controlled trials of the most promising seedling canes now in cultivation. Estate trials of ten varieties specially selected for local conditions have been arranged on twelve estates.

Central Laboratory and Station.

An addition to the present Government Laboratory is to be built for the special and exclusive use of the sugar work. Arrangements have been made for a Sugar Laboratory, a Fermentation Laboratory and an Experimental Distillery.

Sugar Laboratory.—This will be equipped for the special work of analyses of canes, juices, sugars, molasses, still-house products, rum-colouring, &c.

Any estate will be entitled to the free analysis of a sample of sugar and of juice each week of the crop season.

When work permits, the staff will analyse, free, soils or other materials from estates.

All the juices from the experimental plots on estates will be analysed at the Central Laboratory. Experimental work on the utilisation of native sugar for preserves, aërated waters, &c., will be carried out. The chemical examination of Jamaica rum will also be made a special feature.

Fermentation Laboratory.—This will be in charge of the Fermentation Chemist and will be specially equipped for the study of yeasts and micro-organisms involved in the production of rum. This work will be carried out in direct connection with the chemical examination in the Sugar Laboratory.

Experimental Distillery.—A special building and experimental plant to provide for small laboratory fermentations on a 50 gallons scale has been designed. Samples of Dunder, Molasses, Skimmings, Flavours, Acid, &c., will be specially imported from estates in puncheons and barrels. Wash will be set up under various conditions and everything

controlled by Laboratory analyses and observations. A small 50 gallons still with telescopic head and detachable retorts will be constructed to deal with the various types of distillation at present existing in the island. A sufficient quantity of rum will thus be obtained to enable it to be tested commercially and chemically. Careful data as to attenuation and yields will be recorded and tables for use in Jamaica Distilleries will be drawn up and made available.

Nursery for Cane Varieties.—Some six acres of land at the Hope Experiment Station have been established in the cultivation of cane varieties. This is to be exclusively a nursery and distributing medium, the merits of the canes will be worked out on the estates by the varietal tests. At Hope, seedling canes will be raised from selected and cross fertilized seed, the best canes from Barbados and Demerara will be grown for distribution. To ensure the cane cultivation it is proposed to set aside the new reservoir exclusively for the irrigation of the canes. All canes will be distributed from Hope gratis.

Education.—Special courses for the study of sugar and rum have been arranged. Ten book keepers each year will be offered £10 each to cover the expense of attending at the Laboratory in Kingston. These courses will be held out of crop.

Management.—The Board of Agriculture is the Government authority in control of this scheme and of the finances, but it is considered desirable to have a special committee of management consisting of representatives of the Sugar Industry, to supervise the working of the Scheme and to ensure that the experiments are properly directed to meet the practical needs of the industry as a whole. It is proposed that this Committee should report to the Board of Agriculture from time to time as to the progress of the work and shall be responsible for the proper conduct of the Scheme as authorised by the Governor in Privy Council.

The Island Chemist is to be the executive officer in charge of all the operations of this scheme and will act as Secretary of the Committee of Management.

STAFF.

Fermentation Chemist: C. Allan, B.Sc.
Superintendent of Sugar Experiments: T. H. Sharp, jnr., B.S.A.
Assistant Chemist: A. Sime.
Junior Assistants; E. N. Richards and W. H. Redpath.
Chemist in charge: H. H. Cousins, M.A., F.C.S.

AN ENEMY OF THE COTTON BOLL WEEVIL.*

By O. F. COOK, Botanist in charge of Investigations on Tropical Agriculture, U. S. Department of Agriculture.

Specimens of the cotton boll weevil were obtained in eastern Guatemala in 1902. The insects, which were collected on the request of the Division of Entomology, were not found on the cotton cultivated by the Indians, but were very common in the flowers of a tree cotton growing spontaneously near a native house a short distance from the cotton field. The beetles were secured in a rather inaccessible part of Alta Vera Paz, seldom visited by naturalist or other travelers, which lies

* U. S. Department of Agriculture Report No. 78, issued May 27, 1904.

between Cajabon and Sepacuite and is inhabited only by primitive Indians and a very few Spanish-speaking "natives" of mixed blood.

The Indian variety of cotton seemed very small and unpromising, only one or two bolls being borne on a plant. It seemed very strange also that so small a variety should be planted while the large tree cotton was so ready at hand. It was learned, however, from Mr. Kensett Champney, who has most thorough acquaintance with the agricultural habits of the Indians, that this was the only variety of cotton planted by them in this district and the one exclusively relied upon to furnish material for their native fabrics. The absence of the weevils from the small Indian cotton was reported when the specimens of the beetles were brought back to Washington, but the diminutive size of the plant seemed to forbid any recommendation of probable utility in the United States.

Later on, with the increasing acuteness of the boll weevil question and the voting of an especial appropriation by Congress for the study of means of protection against the ravages of this insect, the existence of a variety of cotton in Guatemala which seemed not to be subject to the attacks of the boll weevil was recalled, and it seemed to the authorities of the Bureau of Plant Industry that every clue should be followed up. The Secretary of Agriculture authorized an investigation of the Indian cotton of Alta Vera Paz, to ascertain whether it possessed in reality any quality enabling it to resist the boll weevil, or to learn other causes of its immunity from the attack of the insect. The custom of the Indians to plant their crops every year in tracts of land recently cleared by burning suggested an alternative possibility that if not actually resistant to the weevil the cotton might have an almost equally valuable tendency to quick growth, thus enabling a crop to be obtained before the weevils had time to become injuriously numerous. The importance of securing early varieties has been emphasized as the result of the investigations of the boll weevil in the United States.

In this part of Guatemala the present season has been much more rainy than that of 1902, and the cotton is much larger. Well grown plants bring to maturity from ten to twenty bolls of fair size, and even more. A thorough search shows that the weevil is present and able to injure the cotton, but reveals also an active enemy which keeps it in check. This is a large reddish brown ant which is attracted to the cotton by the food which it secures from three sets of extra-floral nectaries. Each leaf has a nectary on the under side of the midrib, from 1 to 2 centimetres from the base. Each of the large bracts of the involucre has a circular or broadly oval nectary close to the stem, and there is a third series of three nectaries at the base of the calyx, between the pair of small bracts alternating with the larger divisions of the involucre, of which they seem to be morphologically speaking, the stipules. Nectar is also to be found between the calyx and the corolla, but no bees, flies, or other winged insects were observed visiting the flowers except beetles, sometimes the boll weevil, but much more often a small black staphylinid of very active habits. To these and to the very small black ants which are also occasionally present in numbers on the cotton, the large brown ant pays no attention, but the weevil is attacked on sight and becomes an easy prey.

The ant's mandibles are large enough to grasp the weevil around the middle and pry apart the joint between the thorax and the abdomen.

The long flexible body is bent at the same time in a circle to insert the sting at the unprotected point where the beetle's strong armour is open The poison takes effect instantly; the beetle ceases to struggle, and with its legs twitching feebly is carried away in the jaws of its captor. As with many other insects when stung by wasps, the paralysis is permanent; even when taken away from the ants the beetles do not recover. The adroit and business-like manner in which the beetle is disposed of, in very much less time than even the briefest account of the operation could be read, seems to prove beyond question that the ant is by structure and by instinct especially equipped for the work of destruction, and is, in short, the true explanation of the fact that cotton is successfully cultivated by the Indians of Alta Vera Paz in spite of the presence of the boll weevil. Instead of congregating in large numbers on the cotton in the immediate vicinity of their nests the ants have, as it were, the good sense to spread themselves through the field, from two to four or five usually being found doing inspection duty on each plant In some places there seemed to be not enough ants to go around, and here the beetles were more numerous Rarely, too, certain flowers or branches seemed to have been overlooked, beetles being found on the same plants with the ants. In such instances, indeed, the young flower or boll was generally riddled with punctures as though many beetles had availed themselves of a rare opportunity of feeding undisturbed

Cotton growing among the Indians is something of a special art, the community being supplied by a few men aware, as it were, of the secrets of the business. They know nothing about the weevil and its ravages, and ascribe such damage as occurs to other harmless insects, or even to superstitious causes, such as the failure of the owner to abstain from salt at the time of planting. The ant, however, is definitely associated in their minds with cotton, and they do not expect to secure a good crop unless these insects favour the plants with their presence. Some of the Indians give the ant a special name, *kelep*, not applied to any other species; but it is also referred to as "the animal of the cotton."

In the neighbourhood of Secanquim, on the coffee estate of Messrs, Champney & Co., where most of our observations have been made, the ants are by no means widely distributed, and the cultivation of cotton is confined to very narrow limits, where it is planted year after year in closely adjacent places, or even on the same ground. In one instance the same Indian has planted cotton on the same hillside for upward of forty years, with no failure to secure a crop except in one year, as he explained, when he was sick and did not sow! Such facts preclude, of course, any explanation based on the theory of temporary immunity secured from burning over the land or by planting in a new place in which the beetles have not had time to congregate. The cotton is sowed in October or November, a very rainy part of the year, when land can not be cleared by burning, and the weeds are pulled out and thrown with the dead cornstalks and brush into piles, which would protect the beetles rather than destroy them. The perennial tree cotton also furnishes permanent breeding places, so that the conditions are most favourable to the propagation of the beetles in large numbers. The ants, however, are evidently able to hold them in check, and thus permit the regular cultivation of an annual variety of cotton by the Indian.

Ethnological data shows that the weaving of cotton cloth was practiced in tropical America for many centuries before the arrival of Europeans, and the probability is great that the plant itself is a native of this hemisphere In being carried to other countries it was taken beyond the reach of both the friends and the enemies which had developed with it. The boll weevil has migrated northward with the extension of the area of cotton cultivation into Mexico and Texas, but the ant has not yet followed. The question now is, whether it can be induced to do so. The Mexican entomologists seem not to have found the ant in that country, in the northern states of which the weevil has been reported as very destructive.

That the ants are so localized in their distribution in this part of Guatemala has undoubtedly served the better to demonstrate their value as protectors of the cotton plant; it suggests also, with other facts, the probability that they are not native here, but have spread eastward in smaller or larger colonies as the forests were cleared away by the Indians. The present occupation of the eastern districts of Alta Vera Paz by the Indians does not date back more than a few generations, though abundant evidences of much more ancient inhabitants are found in the apparently primeval forests. The ants, like the Indians, probably came from the dry, open interior plateau region, where the center of the aboriginal cotton industry of Guatemala is still located, and where another visit to the ants is to be paid in the next few days. To establish the fact of such an origin for this useful insect would greatly increase the probability of its successful introduction into the United States The acclimatization of a thoroughly tropical animal, requiring continuous heat and humidity could scarcely be hoped for If, however, the cotton ant can survive a long dry season and perhaps cold weather in the tablelands of Guatemala, it might easily learn to hibernate in Texas, as has the boll weevil. The ant, indeed, is much better able to protect itself against frost, since it excavates a nest 3 feet or more into the ground. That it is a reasonably hardy insect is shown also by the fact that several individuals have survived confinement of twelve days without food, and seem now to be thriving on a diet for cane juice. To take worker ants to Texas will be, evidently, a very easy matter, but to secure queens and establish permanent colonies may require considerable time and experiment and a thorough study of all the habits of the species.

Although the cotton seems to be especially adapted to attract the ant by means of its numerous nectaries, the insect is not, like some of the members of its class, confined to a single plant or to a single kind of prey. It was observed running about on plants of many different families, and it attacks and destroys insects of every order, including the hemiptera, and even centipedes. On the other hand, it does not do the least injury to the cotton or to any other plant, so far as has been ascertained, and it can be handled with impunity, having none of the waspish ill temper of so many of the stinging and biting ants of the tropics. Since where once established it exists in large numbers and seeks its prey actively, it is a much more efficient destroyer of noxious insects than the spider or the toad. It seem, in short, not unlikely to become a valued assistant in the agriculture of tropical and sub-tropical

counties, if not in temperate regions. The farmer has a new and practical reason to "consider the ant."

An accumulation has been made, of course, of seeds, specimens, photographs, and notes bearing on the cotton, beetles, ants, and many other collateral matters not to be mentioned here. Even this brief preliminary report should not close, however, without an acknowledgment of the many favours of Messrs. Owen and Champney, owners of the Sepacuite estate, and of Mrs Owen. Without the kind invitations, hospitality, and extensive local knowledge and cooperation of these generous friends, it would have been quite impracticable to visit the Indian cotton district of the interior of Alta Vera Paz in 1902, or to ascertain the existence of the cotton ant in the present season.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House, on Tuesday, May 10th, at 11.15 a.m., present, the Director of Public Gardens and Plantations; the Island and Agricultural Chemist; Hon. J. V. Calder, and H. Cork, and the Secretary, John Barclay.

The Secretary reported that owing to a meeting of the Privy Council then being held, the Hon. Sydney Olivier, Chairman, could not be present—that he had received a telegram from Mr. C. A. T. Fursdon, that he could not attend, and a message from His Grace the Archbishop, that he was suffering from inflammation of the eye and could not be present The Hon. W. Fawcett was asked to act as Chairman.

As regards native cotton seed, the Director Public Gardens reported that he had received from three different sources samples of native seed, which he was planting.

The Secretary read a copy of a communication from the Governor to the Jamaica Agricultural Society with reference to the improvement of horse-breeding, in which His Excellency said that were he going to remain in the Island he certainly would be disposed to endeavour to carry out the recommendations of the Committee. He could not, however, bind his successor to any action The Secretary was instructed to ask the Agricultural Society what they proposed to do in the matter and bring the reply up at next meeting.

A report from the Director Public Gardens and Plantations on the Sumatra Tobacco grown at Hope was submitted, which stated that a Cuban expert had reported that it was of very good quality and could not be known from the genuine Sumatra grown, and that it was better than that grown in Cuba; the value of the best leaf was estimated at from 6/ to 8/ a lb. and inferior quality at about half that price.

The following Minutes from the Chemist were submitted:—

(a) Application of Gerald Brandon for admission as Agricultural Student without fees. It was resolved that he should be admitted, but must pay the fees.

An application from Mr. N. A. Rudolph, Student at Guelph College, Canado, for permission to work at a portion of the Laboratory course and to attend at Hope Gardens for two months. It was decided that permission would be granted on payment of a fee for half the term, of two guineas.

(b) Minute on the Water Supply at Hope, suggesting that the water from the new reservoir should be utilized entirely for cane-growing. The Director Public Gardens said he objected to this; and it was resolved to leave the matter to the Chairman, the Director Public Gardens and the Chemist to settle what should be done.

(c) Protective Treatment of Cotton Seed. It was resolved that this report from the Chemist on the germinating results after soaking the seed in a solution of Corrosive Sublimate should be published in the "Bulletin"

As it was reported there was cotton seed being imported by private individuals, it was resolved to recommend to the Government that all cotton seed imported be fumigated at the port of Kingston, under the Seeds and Plants Protection Law.

(d) Report of the Fermentation Chemist and letter from Mr. W. Woolliscroft on the Rum at Green Park Estate, where recommendations of the Chemist had been made so that rum which had been turning out unsatisfactory had been made of good quality.

(e) Letter re Seedling Canes in Demarara, stating that the new seedlings show a superiority of 30 per cent. over the Bourbon on a period of 4 years; and that cane B 208 was considered the best there.

(f) Analyses of Canes from the Manurial Plots at Caymanas.

(g) Report of Fermentation Chemist

(h) Report Superintendent of Sugar Experiments.

(i) Report visit to Port Maria. It was asked therein if arrangements could be made for Mr. Cradwick to visit the local Agricultural Society there, and suggesting that Mr. Teversham should give a lecture there next month on the "Banana Plant."

The Secretary stated that he had already written the Agricultural Society at Port Maria that Mr. Cradwick would not be available for work in St. Mary until January of next year.

The Board objected to Mr. Teversham being sent out as lecturer of the Board. The Chemist said he would do it on his own responsibility.

(j) Report re Thymol, asking the Board to approve of his preparing a powder and selling it at cost price. This was approved, if the permission of the Colonial Secretary was obtained.

The Secretary read a report re Sea Island Cotton Seed stating that a total of 3,534 lbs. had been sent out, enough to plant over 500 acres. The report was directed to be circulated.

The following reports from Director Public Gardens were submitted and directed to be circulated:—

(a) Hope Experiment Station.

(b) Mr. Cradwick (2).

Minutes re Sweet Potatoes were submitted and were directed to be circulated.

A letter from the Jamaica Agricultural Society forwarding communications from the Hon. W. Fawcett and Mr. T. P. Leyden re Dairying in Jamaica was submitted and directed to be circulated.

The Chemist submitted letters and figures re cost of Cassava growing and this was directed to be sent to Mr. Calder and Mr. Shore for the addition of their ideas and to be brought before the Board at next Meeting.

The meeting adjourned until Tuesday, 14th June, at 11.15 a.m.

THE METHOD OF APPLYING PARIS GREEN.

The following is a letter from Mr. Wm. B. Seabrook, who was in Jamaica a short time ago, giving advice about working Cotton Gins.

He stated when he was here, that cotton planters in the Sea Islands had given up mixing Paris Green with lime, and he promised to send a sample of the material used for bags to put the Paris Green in. This material is known in Kingston as American Grey Sheeting. The bag is 10 inches long and 8 inches broad.

Paris Green is an arsenical poison, and therefore great care should be taken in its use. It is of value for killing insects, such as caterpillars, which feed on the leaves of plants, and it may be applied to lilies, and other ornamental plants subject to caterpillar attacks.

Mr. Wm. B Seabrook to Director of Public Gardens and Plantations, Jamaica.

With reference to the appliance for poisoning caterpillars with Paris Green. I thought it altogether best to make one of the bags which are used by the planters here for handling and applying the poison. You can not only judge of the material, but see the size, shape, and everything about it.* A light staff is provided, like a broom handle, and 5 or 6 feet long. One side of the mouth of the bag is tacked to one end of the staff. The poison is put in the bag and the staff twisted over a little to close the mouth of the bag. The quantity put in is immaterial, since you don't put too much—I suppose about $\frac{1}{3}$ or $\frac{1}{4}$ full, to start with. A little practice will enable the operator to learn all the details. The *pure unadulterated poison* is used—just as it is furnished by the merchant. The most thorough poisoning is done by having the operator hold the bag near the centre of the plants, with the wind blowing the poison among the leaves and branches. A sharp rap with a small stick on the staff is enough to liberate a sufficient quantity of the poison at a time. It is not discernible on the plants after it is applied, but an inspection of the poisoned spots a day or two afterwards will reveal the utter destruction of the worms. Another advantage claimed is that the cotton plant sustains no damage at all when the poison is applied in this way: whereas a too heavy application of the poison will involve plant and worm in one common ruin. Now, there is another point on which success in the application of the poison hinges—it is *to apply it at the right time*—just when the little worms, about half an inch long, commence their work. The delay of a day or two may mean either heavy damage or the destruction of the crop. When the worms are allowed to eat and grow, heavier applications have to be made, as they are not as easily destroyed as when small. In that case the planter suffers double—1st from damage done by the worm, and 2nd the unavoidable damage done by heavy applications of poison.

* The bag is on view at the Office of the Agricultural Society.

I hope I have made it clear to you; but if there is yet any obscure point, or information which you may desire, I shall be pleased to furnish it at your request.

I have the honour to be,

Very truly and faithfully Yours,

(Sgd.) WM. B. SEABROOK.

THE BREADFRUIT.*

By HENRY E. BAUM

(*Continued from the Bulletin for June.*)

NUTRITION.

When obliged to compete with the banana as a food staple the breadfruit has taken second rank on account of its comparatively inferior yield and slower growth ; in the West Indies the banana played an important part in the cuisine of the explorers from the time of discovery, while the aborigines had, in all probability, previously developed an extensive acquaintance with that fruit, and accumulated traditions which were passed on to their Spanish conquerors. Therefore when King George III caused the breadfruit to be introduced into his West Indian islands in 1793, the banana had an overwhelming advantage in being already firmly fixed in the list of traditional food-plants and the usual conservatism of man in changing his food materials prevented an extensive use of the fruit in those islands. Except in a few of the Pacific Islands where the successive ripening of different varieties of breadfruit keep it in season practically all the year, the banana, yam, and taro [cocoe] are the plants chiefly relied upon by the natives. That the breadfruit will not succeed as a food staple when obliged to compete with well established cereals and root crops is generally acknowledged but nevertheless, its utility as a farinaceous food of considerable nutritive value is generally underestimated.

From on analysis given in the Experiment Station Record of the Department of Agriculture (Vol. 12, p. 1076), it would seem that breadfruit contains more starch (25 per cent), and less water (25-30 per cent) than either the yam or sweet potato, but the presence of over 4 per cent of fibrous matter is a great handicap upon its attaining wide use as a vegetable, a disadvantage not shared by either of the plants mentioned. The amount of nitrogenous matter varies a great deal in the different analyses, but the presence of protein enough to justify the following statement is assured :

"The result of the determination of nitrogen in a portion of the pulp of the wasted fruit shows that this esculent must be classed with taro, yams, potatoes, and rice as essentially farinaceous in character."†

The chief obstacle to the commercial exploitation of the fruit is its lack of transportable qualities while in a fresh condition, owing to the fact that it ripens quickly and soon loses quality after complete maturity has been reached. The following quotation gives an idea of the Hawaiian fruit at maturity :

* Reprinted from *The Plant World*, VI., 200 : Sep., 1903.

† Hawaiian Planters' Monthly, 13 : 316. July, 1894.

"When just ripe the fruit contains but little sugar. If baked in this stage, the bulk has a delicately fibrous texture, with a suggestion of 'lightness' that recalls that of a loaf of wheaten bread. The flavour is agreeable and characteristic, reminding one, however, a little of wasted chestnuts."*

Before ripeness is attained, the fruit is dry and rather tasteless, but with complete maturity comes a sudden change of the starch content into sugar, accompanied by a rich peach-like aroma, but with no corresponding change in flavour ; even this odour is lost in the process of cooking. According to Mr. Lyon the fruit in this over ripe condition is soft and gummy, but is preferred by many on account of its pronounced sweetness.

Captain Cook, while on his first voyage round the world, made the acquaintance of this vegetable-tree and has left the following rather extravagant record in his monumental folios of travel:

"Of the many vegetables that have been mentioned already as serving them for food, the principal is the bread-fruit, to procure which costs them no trouble or labour but climbing a tree. The tree which produces it does not indeed shoot up spontaneously, but if a man plants ten of them in his life time, which he may do in about an hour, he will as completely fulfil his duty to his own and future generations as the native of our less temperate climate can do by ploughing in the cold of winter and reaping in the summer's heat, as often as these seasons return; even if, after he has procured bread for his present household he should convert a surplus into money and lay it up for his children."

It was through such indiscriminately bestowed praise tha the English were led to send expeditions into the Pacific to obtain the plant for the West Indian colonists, with the resulting reward of disappointment in its qualities.

Culture.

The tree grows best in hot countries having a considerable amount of atmospheric moisture and reaches its highest development in the tropical islands of the Pacific and in the Malay Archipelago, the original home of the fruit. Hawaii is the northern limit of cultivation in the Pacific, the tree growing there in abundance, but with little of the luxuriance attained in the southern islands, while on nearly the same level of latitude in the Presidency of Bengal in India, all efforts at cultivating it have been defeated by the stunting of the summer growth by the frosts of winter. Even in Madras, about a hundred miles farther south, the tree has not become thoroughly acclimated after years of cultivation The West Indian climate is also not considered ideal for its culture, although it is likely that portions of the moist northern slope of Porto Rico are well adapted to the commercia growth of the breadfruit. The islands of the lesser Antilles and the shores of Central and South America bordering on the Carribbean Sea seem to afford congenial localities, but it is in Brazil that its highest development in the New World is attained. It is not out of the range of possibility that the fruit was brought by the Portugese to their South American dependencies before the French and English supplied their West Indian colonies by importations from the east, as in Brazil a longer series of uses was developed

*Hawaiian Planters' Monthly, 12 : 315. July, 1894.

than in any other part of America, and mention has already been made of its entry by Pearson under the name of "Brazilian bird lime." The Mango was also brought to Brazil some years before it reached the West Indies. The cultivation of the tree in these regions, however, does not extend much beyond the coast, being restricted to the warm, moist coastal plains or inland places with similar climatic conditions.

The tree grows sparsely in the United States in Florida, where the fruit can scarcely be had in sufficient quantities to justify its culture for commercial purposes, although a few cases of successful wintering in the open air have been reported as far north as Manatee

(To be continued.)

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE.*

By O. F. Cook, Botanist in Charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

Among the more striking results of the industrial progress of the nineteenth century was the rapid multiplication of the uses of rubber and an ever-increasing demand for the raw material. For several decades the world's needs were met by the Para district of eastern Brazil, but with steadily advancing prices as an inducement the entire Amazon Valley, and indeed all tropical regions of both hemispheres, have been ransacked in search of additional wild supplies. It is not yet true, as sometimes represented, that the natural product is exhausted or that a rubber famine is to be anticipated at an early date. Within the last decade the value of good grades of rubber passed from the neighbourhood of 25 cents to a dollar and upward per pound, and the rubber-gathering industry met with an expansion sufficiently rapid to more than keep pace with the demand, so that a period of somewhat more moderate prices has ensued. But with a steady increase in the use of rubber in the arts and no very general improvement in the destructive methods of gathering the wild product, it is to be expected that this respite will be brief and that the question of the world's future supply will soon become more acute.

The preservation of the wild rubber forests is naturally receiving more and more attention in the countries in which they are so important a source of wealth, but measures of safety are least likely to be applied in the very remote and unexploited districts where they would do the most good. Rubber is still very largely a product of savage rather than of civilized industry; in fact, it is now by far the most important contribution of barbarous races to our industrial civilization. While this continues to be the fact there will be little change in the careless and wasteful methods of the past, but the appreciation of rubber forests as permanent sources of income may be expected to increase, so that the continued advance in the price of rubber no longer means merely the rapid extinction of wild rubber trees, but implies also increased interest in the protection and improvement of the more productive natural forests. Such a tendency is already manifest, es-

* Extracts from U. S. Department of Agriculture, Bull. No. 49, Bureau of Plant Industry.

pecially in Brazil and in adjacent countries of South America, and probably means that the natural supply of rubber will never entirely cease, bnt will gradually become the basis for the development of scientific forestry in the Tropics. There is, however, no probability that any large proportion of the present producing areas will become permanent sources of supply, and the cultural production of rubber well deserves the serious consideration it is now receiving in all agricultural regions of the Tropics.

Rubber culture is no new or recent proposition, since beginnings were made nearly three decades ago. With an annual plant twenty years of experience would teach us much, but for dealing with long-lived trees that period is very short, and it need not be a matter of surprise that rubber culture is still in the experimental stage Many cultural mistakes are still made with plants that have been in domestication for thousands of years, and the failure of the first attempts with rubber might have been predicted simply on the grounds of probability. Nevertheless, a distinct period of discouragement resulted, the effects of which are still felt and will doubtless remain until more detailed knowledge makes plain the possibility of avoiding the obstacles previously encountered.

Progress in practical matters as well as in purely scientific subjects depends much upon theories. On the failure of the first experiments, the theory that rubber trees could be profitably cultivated was discarded by many who came to the conclusion that planted trees will not produce rubber. This view is by no means extinct, especially among those who have abandoned rubber planting in disgust An adverse opinion of this kind is popular with some because it serves as a general explanation of failure and spares the annoying suggestion of cultural errors and oversights.

Like other members of the vegetable kingdom the performances of rubber trees have been found to depend upon the conditions under which they grow, whether planted or self sown, unless they were injured in planting. In the American Tropics and in the East Indies the possibility of the cultural production of rubber has been demonstrated. This fact is giving the pendulum the return swing in the direction of sanguine expectations, and the assurance that rubber can be produced culturally is too often taken as a verification of the original estimates of yields and profits in spite of the fact that some of these have been disavowed by their authors. A future of easy prosperity for the rubber planter is held to be assured, and the opinion that rubber culture is still experimental is resented as blindly conservative. The lesson of the former miscalculation is forgotten by the new generation of promoters, and the fact that rubber trees have been found to thrive in a given locality is taken as sufficient evidence that they will meet even the most reckless estimates of productiveness and profits. The opening of large plantations under untried conditions in Porto Rico and the Philippines is advocated, and the investing public is assured, in effect, that the returns from rubber culture are to be so great that the exercise of ordinary agricultnral skill and business caution is unnecssary, though the fact remains that a large measure of both is likely to be required if the numerous unsolved problems of the new industry are to be overcome without ruinously expensive experiments.

THE STATUS OF CASTILLOA* RUBBER CULTURE.

Many current discussions turn upon the question whether rubber culture is still in the experimental stage. This is the most frequent objection of those who lack confidence in rubber culture, and naturally arouses a strong protest from those who insist that rubber planting is the safest and most remunerative branch of agriculture.

It is true that rubber culture is no longer a new idea, since it was considered by the Government of British India as early as 1872, and Castilloa was introduced into India in 1876. The Hon. Matias Romero, formerly minister from Mexico to the United States, also began to write on the subject of rubber culture in 1872. But the success of rubber culture can scarcely be demonstrated from the experiments of twenty or thirty years ago, since the results of few, if any, of these appeared sufficiently promising to justify their continuation. The plantation of Señor Romero was located in the Soconusco district of the State of Chiapas, in southern Mexico, and was early abandoned. The small plot of trees visited by the writer at La Zacualpa, some 60 miles northwest from Tapachula, was probably planted as a result of the interest aroused by Señor Romero in this vicinity. The trees at La Zacualpa were set, however, as shade for cacao, and not as an independent culture. This was not the only experiment with rubber planting in the same region, but it seems to have been the only one which resulted favourable enough to call for the further investment of capital in the commercial production of rubber.

There have been, and still are, three general opinions regarding rubber culture. The first is that rubber can be produced at profit wherever the trees will grow. The very frequent failure to secure rubber in paying quantities from planted trees gave rise to the second opinion that rubber could not be produced in cultivation. But these ideas are beginning to give place to the third and more rational view that rubber, like other agricultural crops, can be produced profitably only under favourable conditions, or, in other words, rubber culture may be said to have reached the stage when it can no longer be indiscriminately advocated nor indiscriminately condemned. If no other evidence were obtainable, the planted trees visited in Soconusco would prove that rubber can be produced in cultivation, and the investment of millions of dollars in Castilloa culture in tropical Mexico and Central America may be taken as evidence that many are convinced that such production will be profitable. It is most unfortunate, however, that so many of those who have been attracted by the recent revival of interest in the subject have accepted the first view rather than the third, and have thus needlessly jeopardized their capital by attempting to grow rubber under conditions which the older experiments have shown to be more or less unfavourable.

When it is claimed that rubber culture has passed the experimental stage, this should be taken to mean that the agricultural production of rubber has been demonstrated as possible. But from the agricultural standpoint it is even more true that rubber culture has only entered the experimental stage, since very little is known regarding conditions, methods, and results.

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* Prof. Cook prefers the spelling Castilla.

CASTILLOA VERSUS HEVEA.

The preceding paragraphs may serve to explain why no decision has been reached on the very important question of the relative agricultural value of the different rubber-producing trees. It has been supposed thus far that the climatic and cultural requirements of the Para rubber tree (Hevea) and the Central American rubber tree (Castilloa) were quite different, but the results of the present study seem to indicate that the differences, if any, have been much overestimated The comparative experiments thus far carried on in botanical gardens have, at most, but a local value, and can not be accepted as final. In Java, for example, both Castilloa and Hevea were condemned in favor of *Ficus elastica* (Assam rubber), but it now seems probable that the continuously humid mountainous district in which the experiments was tried was quite unsuited for testing the productive powers of Castilloa, and probably of Hevea also.

It may be that no one rubber-producing species will attain any great or exclusive preponderance, but that different climatic and soil conditions can best be met by planting different trees. The wisest policy in untried regions will be to make experimental plantings of all of the more promising rubber trees. At present these are three in number: Castilloa, Hevea, and Ficus. Manihot (ceara rubber) can probably be omitted from the list except for regions too dry for the others.

UNCERTAINTIES ATTENDING RUBBER CULTURE.

Some few rubber planters have not been contented to plant anywhere that the rubber trees could be made to grow, or even where they grew wild, but have emulated the northern farmers who planted young sugar maples close by the productive parent trees. Some of the plantations of Mexico seem to be outside the natural range of Castilloa, as they have found it necessary to import the seeds from other districts. Others are in localities where the rubber tree grows wild but produces little or no rubber. For example, in Soconusco it would be entirely possible to establish a rubber plantation on the lower slopes of the mountainous and humid coffee district, where wild Castilloa is not uncommon. Fortunately, however, rubber planting has been confined to the warmer and drier coast plain and to localities where both wild and planted trees have been found productive. That it will become possible by correct method to produce rubber in countries where the tree is not native. and even in localities where the wild trees do not yield well, is to be expected, but it can scarcely be repeated too often that the planting of more than experimental quantities under untried conditions is a hazardous enterprise, to say the least, and not to be indulged in except by those who can afford to lose.

In the British dependencies of the Malay peninsula, Para rubber for several years past has enjoyed an era of rapidly increasing popularity, heightened recently by the fact that some of the earlier plantings have begun to produce and that good prices have been obtained for the samples shipped to Europe. But even yet the prize of success may escape, since it appears that the new East Indian Para rubber, though received with high approval by the importers, has been found seriously defective in quality.

We have already expressed our opinion of samples of the cultivated rubber from the Malay states, which, while attractive in appearance, do not really resemble the fine Para rubber now in use. It is much softer than the Brazilian product, and of much shorter "fibre." It could not be used, for example, in thread, elastic bands, or any fine, pure gum goods. In solution, it quickly loses its tenacity, so that it would not do for high-grade cements. And it readily softens with age. Perhaps some of these defects might be removed by the introduction in the East of the methods of coagulation employed in the Amazon rubber camps, but we are disposed to believe that the Eastern planters have really produced a new grade of rubber, and that the Para article can never wholly be duplicated by them. It is to be understood, of course, that the rubber is valuable, and will find a ready market at a price which is likely to yield a profit, but such samples as have reached us, valued from the manufacturers's standpoints, would rank at least 25 per cent. lower than fine Para.

The good prices realized in London, doubtless, have been due to the cleanly appearance of the new rubber. And they have been based on the judgment of brokers, rather than results of practical tests in the factory. * * * The manufacturer's test is the one by which the value of this rubber will be judged finally, regardless of what may be the judgment of brokers to-day. We do not mean to dampen the enthusiasm of the planters, but there is such a thing as basing their plans upon estimates of profits that are impossible.*

It is certainly to be hoped that this disappointing report can be traced to some accident to the samples condemned, or that the quality will improve as the trees increase in age. And yet it may not be a matter of surprise that with rubber, as with so many other natural products, perfection will be found to depend on some apparently trifling and long-overlooked peculiarity of soil or climate.

But whatever the true merits or prospects of the Para rubber industry of the East Indies the above report well illustrates the vicissitudes of hope and failure to which new cultures must remain subject until scientific knowledge and practical experience have revealed the principal factors and shown something of their relative significance.

It it impossible to tell in advance which fact will be of directly practical importance in the development of a new and complicated subject like rubber culture. Nothing should be disregarded which tends to bring the rubber-producing species into relation with the facts which have been accumulated with regard to other plants, or which can serve as a suggestion for the solution of any of the all too-numerous problems.

HABITS OF CASTILLOA IN THE WILD STATE.

There is a popular impression that in order to domesticate a plant it is necessary to place it under the same conditions as in the wild state, but as a matter of fact our cultivated plants generally have much better conditions than their wild relatives. It is easy, however, to overlook some essential requirement of a new culture, and it is a distinct advantage to understand as thoroughly as possible the habits of a wild plant which it is desired to domesticate. The tamarack and the cypress, for example, are in nature confined to swamps, but they grow as well or better when planted on dry ground. The difficulty is that without human assistance they are unable to establish themselves on dry ground. Similarly, it has been inferred regarding Castilloa that it is a shade-loving plant because it is found wild only in the forest. It is known, however, that it is thus limited in nature because the seed is so thin skinned and short-lived that there is no possibility of its surviving exposure to the open sun on dry ground, and it is abundantly proved

* India Rubber World, 1902

that young trees planted by man in the open are able not only to resist exposure to the sun, but that they actually thrive better than those planted by natural agencies in the forest. This fact should be sufficient for the purposes of practical agriculture, unless there are reasons for believing that more rubber can be produced in the forest. This is sometimes argued on the ground that Castilloa is a native of dense forests and can not be expected to yield as much rubber under other conditions. If, however, it is true that Castilloa, or at least *Castilloa elastica*, is not a forest tree in any extreme sense of the words other reasons will be needed to justify shade planting.

THE RUBBER TREE AND THE TRUMPET TREE

Castilloa is a relative of the trumpet tree (Cecropia) and has a similar place in the general economy of nature. Cecropia is widely distributed in the Tropics, but is not looked upon as a true forest tree. It is what might be sermed a tree weed It shoots up with great rapidity, and is able for a time to keep ahead of the other vegetation which in most tropical countries promptly takes possession of land neglected after cultivation. Cecropia is thus one of many plants which have received indirect advantage from man's agricultural operations, and it is seldom found in great abundance except where larger growth has been cleared away. In the undisturbed forest it can not withstand the competition of the long-lived hard-wood trees and is found but sparingly, being limited to openings made by fallen timber, forest fires, changes of river channels, and other accidents which give it an opportunity for growth The same appears to be even more true of Castilloa. Scattering trees are probably to be found at greater or smaller intervals throughout the forests of low elevations, but there seem to be no indications that they exist in numbers except in forests of rather open growth, such as those which produce also the large palms of the genus Attalea, and which there is reason to believe do not represent a truly primeval condition or one of complete forestation, though the last clearing may have taken place centuries ago.

CASTILLOA NOT A GENUINE FOREST TREE.

The native population of the Central American region is commonly supposed to have been much more numerous previous to the Spanish conquest, and the numerous and widely distributed ruins prove the former existence of relatively civilised communities in localities which even in the time of Cortez were apparently forgotten and overgrown with forests as they are to-day But notwithstanding the former civilization of these regions, there seems not to have been found anywhere in Central America an indication of permanent agriculture, such as terraces, walls, or irrigating ditches. The agriculture of the ancient Indians was probably like that of the modern, in that each head of a family cut down and burned each year a new piece of forest to plant his farm or "milpa." Where the population is large and old forest is no longer accessible the second and successive growths are cut at intervals of a few years until the tropical rains have washed away all the fertile surface soil and the district becomes, for the time, a desert, and is abandoned by its human inhabitants Such deserted country is covered first by a coarse grass and then by a scattering growth of pines, which are in turn crowded out by an invasion of tropical forest vegeta-

tion, at first in the more sheltered and humid ravines and valleys and then over the whole area At low elevations the trumpet tree and Castilloa form a part of the vanguard of the new growth, and the Attalea palm is its most striking species. But it is only a question of enough time for these and their accompanying species to be overcome and well nigh exterminated by what may be termed the permanent forest.

When one sees the Indians of to-day clearing, burning, and planting precipitous and scarcely accessible cliffs it becomes easy to believe that little fertile land in Central America, if any, is occupied by truly primeval forest, and easy also to understand that the abundance and wise distribution of Castilloa may depend upon human activity even more than upon natural agencies. Arguments based upon the assumption that Castilla is a genuine forest tree may accordingly be dismissed as of little agricultural significance.

Mr. O. H Harrison, manager of the rubber estate at La Zacualpa, was much interested in this view of the place of Castilloa in nature, because he had already noticed that clusters of wild Castilloa are met with in the forests only where some natural or artificial clearing had been made. Moreover, an examination of the literature of rubber shows that the facts are not new, though their significance has been concealed by the explanation which accompanies the following original account of the details learned from the rubber gatherers of Nicaragua:

The trees prefer humid and warm soils, but not marshy, clayey, or gravelly ground, and the presence of these trees is looked upon as an indication of a fertile soil. It is not distributed irregularly through the forests, but sometimes in little groups, more or less isolated, such a group being termed a *mancha* (spot). This grouping is the normal state, and is believed to be caused by monkeys dropping the seeds near an isolated tree, as they are very fond of the pulp by which the seeds are surrounded. The trees are distributed in vetas (veins) or bands, either in a north-to-south or east-to-west direction, the first probably caused by monkeys, by the trees being on a declivity, or by water, and the second by the wind, which daily blows in that direction. This irregular distribution has led M. Levy to the opinion that in cultivation they should be interspersed between other trees rather than form separate plantations, as he thinks that this sympathetic and antipathetic tendency should not be lost sight of. The hule is often near water courses, and nearly always on the banks. Trees of small groups give a better net produce than those composing large groups*.

From the scientific standpoint these explanations appear quite inadequate, since the causes which they suggest are those which are in continuous operation, and if effective in spreading Castilloa at the expense of other forest trees would have given it a general preponderance long since. All the facts are, however, comprehensible on the supposition that the growth of Castilloa depends upon opportunities which are relatively infrequent in undisturbed forests, as compared with regions inhabited by the Indians and subject to their primitive agriculture.

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*Collins, Report on Caoutchouc, pp. 14 and 15.

(To be continued.)

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. AUGUST, 1904. Part 8.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
HOPE GARDENS.

1904.

JAMAICA.

BULLETIN

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Vol. II. AUGUST, 1904. Part 8.

RUBBER IN JAMAICA.

Notes on Rubber trees were published in the Bulletin for 1894, 1895, and subsequent years.

It has been universally understood that with the exception of the Ceara Rubber, other rubber plants only succeed in districts that are moist; and the planting of rubber trees has not been pushed in Jamaica for fear of interfering with the cocoa and banana industries. Large numbers of plants, however, especially of Castilloa, have been distributed from the Gardens with a recommendation to plant them along fences to serve as fence posts if they turned out to be of no value for rubber.

Experiments have been made in growing Castilloa, the most promising for Jamaica, both at Castleton and Hope Gardens. Contrary to expectation, it has been found that Castilloa succeeds better in the open than under shade, and this has been confirmed by experiments made by Mr. J. Shore at Cinnamon Hill.

In the extracts now appearing in the Bulletin on Castilloa in Central America by Prof. Cook, it is shown that a dry season seems to be necessary for the full supply of rubber.

It will be well therefore to experiment with Castilloa in districts where bananas and cocoa do not thrive.

Reference was made in the Bulletin for 1894 (pages 110, 111) to a rubber tree growing at considerable elevation in the mountains of Colombia. Frequent efforts have been made to obtain plants or seeds, but hitherto without success. However, lately a few have been received from Mr. Robert Thomson, and they will be distributed in the Blue Mountains.

REPORT ON WORK OF AGRICULTURAL STUDENTS FOR EASTER TERM 1904.

By H. H. COUSINS, M.A., F.C.S., Island Chemist.

Six Students attended the course on Agricultural Science at the Government Laboratory during the term.

The conduct and work of the Students was quite satisfactory. It is to be regretted that more Students and with a better School preparation have not been forthcoming.

The present enterprise can only be regarded as a nucleus for a wider development when circumstances permit.

Subject.	Term's Work.	Remarks.
Economic Botany.	Lessons in exter al morphology of Plants, and classificat on of Economic Plants.	Interest shown by all. W Fawcett.
Practical Agriculture.	Study of the practical details of cultivation of Coffee, Vanilla, Canes, Bananas, Pines, Grapes. Budding Man oes, Cocoa, Sapodilla, Citrus, Nutmeg, Avocado Pears.	A decided improvement upon last term. T. J. Harris.
Agricultural Botany.	Study of the principles that guide the scientific planter in the cultivation of the above crops. Taken in conjunction with the practical work.	Followed wi h apparent interest. T. J. Harris.
Agricultural Chemistry.	Manures. Their source and composition. Valuation of manures. Estimation of Nitrogen in Nitrate and Sulphate of Ammonia.	All Students did very satisfactory work. T. F. Teversham.
Botany.	Vegetative and sexual reproduction in plants. Commenced work on Internal Morphology.	The work done was satisfactory. I suggest that a more thorough practical course would be most helpful to the Students. T. F. Teversham.
Physics.	Moments. Centre of gravity and revision.	Satisfactory. T. F. Teversham.
Agriculture.	In the hours for Agriculture I took the subject of Manures and Manuring so as to get this work finished by the end of the term. T. F. Teversham.	

Subject.	Term's Work.	Remarks.
Chemistry.	Sulphur. Silica. Chlorine and their more important compounds. Relation of volume of a gas to change in temperature and pressure. Qualitative and Volumetric Analysis.	The theoretic l work needs more care. Students inclined to pay all their attention to the Practical. T. F. Teversham.
Mensuration & El. Trigonometry.	Measurement of area and cubical contents. Measurement of angles. Trigonometrical ratios.	Satisfactory. T. F. Teversham.
Microscope work.	I was absent on leave till the last three weeks of term. H. S. Hammond.	
Book-keeping.	Cash Book, Purchases Book, Sales Book, Ledger Posting, Discount, Cheques.	Work satisfactory. J. H. Roberts.
Veterinary Science.	Elementary Anatomy of the Horse. Treatment of Organic Diseases. Stable Management.	Work satisfactory. J. M. Gibb.
Entomology.	I was absent on leave till the last three weeks of term. H. S. Hammond.	
Practical Chemistry.	Class I. *Quantitative estimation* of (1) $Ca\,C\,O_3$ in marble Iceland spar and soil (2) $P_2\,O_5$ in Super and Basic Slag (3) N, $P_2\,O_5$ & $H_2\,O$ in Bat Guano. Class II (Martinez) *Qualitative*—Church I to XXVIII.	Class I. This work was not entirely satisfactory. The Students did not devote the necessary forethought and personal effort necessary to make this work successful. Class II. Good. E. J. Wortley.
Essay-writing, &c.	Essays on matters of Agricultural importance. Reviews and summarising of Agricultural papers.	Fair. E. J. Wortley.

PROGRESS REPORT ON THE USE OF NATIVE SUGARS FOR PRESERVES.

By H. H. COUSINS, M.A., F.C.S., Island Chemist.

This subject was considered to be of importance to the sugar industry of Jamaica and the Sugar Department is engaged on an investigation of the matter. The following results have been already obtained :—

Samples of Sugars.

Brown and White Vacuum Pan Sugars were obtained from merchants and sugar planters, as follows :—

Estate.	Sugars. Description.	Polarisation.
		%
Belleisle	White	98.9
	Brown	98.2
Caymanas	White	99.0
	'Yellow Demerara'	96.9
Per Messrs. Myers	White	98.6
Per Messrs. Wray & Nephew	Brown	96.1
Cinnamon Hill	Brown	98.6
Do.	Fair	99.8
Serge Island	Brown	98.4
Worthy Park	Brown	99.3

These data are very creditable to our Jamaica Sugars. The sugars from Cinnamon Hill and Worthy Park were of unusual purity and nearly chemical sucrose. Some of the other sugars were somewhat damp and moist. We have, regularly produced in the island, a supply of sugars well fitted for preserving if properly sterilised. We found, however, that all these sugars were more or less infected with a species of *Torula* with a powerful fermentive action. All these sugars rapidly developed this organism when introduced into sterile nutritive media, even in the proportion of equal parts sugar and medium. This shows that unless perfectly sterilised, the native sugars could not successfully be used for preserving in the usual proportion of half sugar to half fruit.

Experiments in Sterilisation and with Preservatives.

Neither *Boric Acid* nor *Formaldehyde*, within the limits at all permissible in a food product, were effective in preserving fruit pulp. *Sulphur Dioxide*, however, proved strikingly effective and it was decided to select this preservative as the best and least harmful agent for preserving fruit pulp and jams.

Provided sterile conditions could be maintained in the containing vessel, steaming proved completely effective in preserving both pulps and jams made with native sugar.

It was found, however, under commercial conditions of packing, that marmalades made with native sugars fermented. By adding ½ per cent. *Calcium Bisulphite* solution of specific gravity 1.068

all marmalades made with Jamaica Sugars have kept perfectly. The preservative is harmless and was not found to affect the flavour of the marmalade.

Mango Jams.

A number of mango jams made with the native sugars before and after treatment with sulphur fumes, have kept to date—6 weeks. No difference can yet be seen between the treated and untreated jams. A longer trial is necessary before any conclusions can be drawn.

Pine Slices in Syrup.

A trade to the United States in cut slices of pine packed in barrels in a secret preservative liquid (? salicylic acid) flourished for a while, but has, I understand, been destroyed by the prohibition of the preservative by the United States Government. Our experiments indicated that a half per cent. solution of Calcium Bisulphite was an efficient preservative for raw sliced pines with or without native sugar in the form of syrup. It is hoped that this trade may be resuscitated, as bisulphite could not be prohibited as dangerous to health.

Conclusions.

1. Our best native sugars are of high quality, but are all infected with the fermentive *Torula* and special treatment is required to ensure a sterile preserve.

2. *Sulphur Dioxide and Calcium Bisulphite* appear to be the best chemical preservatives for fruit pulp, fruits in syrups and jams made with native sugars.

Present Action.

I am importing a supply of bisulphite with a view to preparing some small commercial samples for shipment to England and America. Mr. T. H. Sharp, jr., carried out most of this work under my direction, and has shown himself a careful and reliable worker in the Laboratory.

BOARD OF AGRICULTURE.

The usual monthly Meeting of the Board of Agriculture was held at Headquarter House on Tuesday June 14th, 1904, at 11.15 a.m. Present—His Excellency the Acting Governor in the Chair, the Director of Public Gardens; His Grace the Archbishop; the Hon. H. Cork, Messrs. C. A. T. Fursdon, J. W. Middleton and the Secretary John Barclay.

The Chairman introduced Mr. H. Clarence Bourne, the Colonial Secretary to the Meeting.

A Letter was read from the Agricultural Society intimating that His Excellency Sir Augustus Hemming had re-appointed the Hon. H. Cork and Mr. C. A. T. Fursdon to represent the Society on the Board of Agriculture.

A memorandum was submitted reporting that the Sumatra tobacco when made into cigars, had not turned out so well as was expected. Samples of cigars made with imported Sumatra wrapper and a Hope grown Sumatra wrapper were submitted for inspection. The Director of Public Gardens said that the necesary conditions, viz., damp nights, did not occur at Hope, for the proper curing of the Sumatra leaf, but if the experiment was to be repeated they might try to overcome the difficulty. It was agreed to repeat the experiment at a cost not exceeding £25.

The Secretary reported that on the matter of Horsebreeding the Agricultural Society had considered and approved of the proposals aud their Secretary was to bring the matter to the notice of the new Governor when appointed.

A letter was read from the Colonial Secretary intimating that the Scheme submitted by the Board for utilizing the Imperial Grant of £10,000 for Sugar had been approved by Sir Augustus Hemming in Privy Council and that the Director of Public Works had been directed to proceed with the extension of the Laboratory at once. Mr. Cork desired that it should be recorded in the Minutes, that he objected to this Scheme.

A report from Mr. Cradwick was submitted recording that he had inspected cotton cultivations on the Pedro Plains and found them satisfactory so far as the cultivation and crops were concerned, but the great want now of the people was to find a market for their first small quantities, else they would be discouraged.

His Grace the Archbishop said that he was very much interested in this attempt to establish a profitable industry suitable for the circumstances of these plains, and he hoped that the Board could come to some solution of the question of finding some immediate market for the quantities already grown and being grown by the settlers there. A committee consisting of the Hon. W. Fawcett, Messrs. C. A. T. Fursdon, J. W. Middleton and the Secretary was appointed to consider what might be done, and so draw up a report as to the position of the industry.

Mr. Fursdon asked what was to be done with the cotton from the Prison Farm which he had ginned. The Secretary was instructed to see if it could be sold in Kingston for stuffing mattresses, sofas, &c.

The Secretary submitted letter from the Colonial Secretary authorising him to supply enough Paris Green to treat the experimental cotton plots receiving the £5 grants.

A report from the Secretary was submitted, showing that a total of 4,225 lbs. of Sea Island Cotton seed had been sent out, sufficient to plant 700 acres. There was only a balance of 36 lbs. of the supply left in hand.

A letter from the Colonial Secretary transmitting a copy of an order fixing the 1st of August as the date from and after which the exportation of any packages of agricultural produce not marked as specified under the amendment of the Produce Protection Law of 30th May, 1904, shall be prohibited.

A report from Mr. Cradwick on the subject of a disease causing the dropping of young coconuts was submitted and directed to be published.

Minutes from the Chemist were submitted :—

(1) re Fibre of Dagger Plant giving reports of the samples sent to London, the conclusion being that it was of no commercial value to Jamaica.

(2) Report of work of Sugar Department for May.

The Director of Public Gardens submitted :—

(1) The Itinerary of Mr. W. J. Thompson for June.

(2) Report Hope Experiment Station.

(3) Mr. Cradwick's work for June.

The Archbishop said he would call attention to a paragraph in the "Agricultural News" regarding the Chinese or Dwarf banana, the cultivation of which Sir D. Morris was advocating in Barbados and they were being shipped from there. These bananas were apparently preferred in England.

Mr. Cork stated that this was good for a special trade with England only and that he was cultivating the variety to a small extent, but had difficulty in getting suckers. The bulk of the banana trade was, of course, with the United States and they did not want this variety there.

The Director of Public Gardens submitted Minute informing the Board that Mr. Robert Thompson had offered to the Board the remainder of his Colombian cassava plants for £10. There were 27 rows, which would give an average of 100 cuttings per row, making the cost less than 1d. each. The purchase of these by the Director was approved.

Mr. Cork asked if the King's Hereford Bull could be taken to the Show at Hope, and the Secretary was instructed to ask the Board of Management of the Agricultural Society if they could arrange for this.

The Chairman said that it had been thought desirable that the Superintending Inspector of Schools should be added to the Board so that he might be kept in touch with what the Board was doing in relation to agriculture and elementary education, but to balance the addition of an official member, he would like to add Mr. J. W. Middleton permanently to the Board as an agricultural and commercial member.

This was agreed to.

TWO NEW FERNS OF THE GENUS POYPODIUM, FROM JAMAICA.*

By WILLIAM R. MAXON,

Aid in Cryrtogamic Botany, Division of Plants, U. S. National Museum.

The two species of Polypodium here described as new were gathered in the Blue Mountains of Jamaica by Prof. L. M. Underwood and the writer in the spring of 1903. Both were fairly well characterized by Jenman in his synoptical list of the ferns and fern allies of Jamaica, but were, however, associated wrongly by him, in the one case with an extralimital species, in the other with South American plants doubtfully the same and, at any rate, under an untenable name. The writer is indebted to Professor Underwood for the privilege of examining the material of the Jenman herbarium now preserved in the collections of the New York Botanical Garden.

POLYPODIUM RIGENS SP. NOV.

Plant 15–28 cm. high, with 10–15 slender rigid fronds: rhizome about 4 mm. thick, elongate, short-creeping or ascending, the grayish inconspicuous chaff noticeably iridescent under a lens, narrow, long-acuminate: stipes 2–4.5 cm. long, rigid, for the most part closely set, dark brownish, thickly covered with long spreading bright-brown hairs; laminæ 13–23.5 c.m. long, 1–2 cm. broad, linear or linear-lanceolate, tapering from near the middle to both apex and base, erect but usually arcuate toward the apex, dark-green above, conspicuously lighter on the under surface, coriaceous, opaque, cut to the blackish rachis into 45–60 pairs of alternate approximate pinnæ; pinnæ exactly oblong, regularly rounded at the apices, the largest (near the middle of the lamina) 10 mm. by 3.5 mm., decreasing in size very gradually above to give rise to a terminal cauda, which is crenate and finally entire, decreasing rather more abruptly below, the lowermost pinnæ minute (2 mm.), slightly more distant, more or less subopposite and dilated upon the upper side; the upper two-thirds of the lamina soriferous, the sori borne midway to the margins (4–6 pairs to each pinna) on the obscure free simple veins, the sporangia mixed with a few bright-brown hairs, similar hairs borne rather abundantly on both sides of the rachis but sparingly along the midveins and sterile veins on the under surface; the sori at length nearly or quite confluent, covering the surface of the pinna from base nearly to apex and against the revolute margins.

Type in the United States National Herbarium, no. 427566; collected from trees on the heavily wooded upper slopes of John Crow Peak, Jamaica, altitude 1,650–1,800 meters, by William R. Maxon, *no. 1,346*, April 18, 1903. The type sheet comprises two plants and several detached fronds, all of which are perfectly characteristic of the species as represented by the following specimens, all from Jamaica:

* Proceedings U. S. National Museum, Vol. XXVII—No. 1374.

Highest slopes of John Crow Peak, altitude 1,650–1,800 meters, *Underwood nos. 806, 2,456a; Maxon no. 1294.*

Base of John Crow Peak, altitude 1,500–1,650 meters, *Underwood no. 2387*; *Maxon no. 1260.*

New Haven Gap, altitude 1,650 meters, *Underwood nos. 973, 1083, 1084*; *Clute no. 111.*

Morces Gap, altitude 1,500 meters, *Underwood nos. 509, 643*; *W. Harris no. 7127.*

Blue Mountain Peak, *W. Harris no. 7487.*

Cinchona, altitude 1,500 meters, *Underwood no. 2626.*

Specimens of this plant were referred by Jenman to* *Polypodium rigescens* Bory† described from the island of Bourbon. From that species, however, *P. rigens* differs markedly in several characters upon which Willdenow laid stress in his original description of the latter species, and which were further brought out by Hooker and Greville upon the occasion of their figuring an authentic specimen.‡ It is distinguished by the hispid-pilose covering of its vascular parts (*P. rigescens* is described and figured as glabrous throughout), by its greater size and relatively greater breadth, and by the oblong rather than ovate-oblong shape of the pinnæ. In these differences the Jamaican plants are perfectly constant.

The species is apparently not rare in Jamaica. Jenman's remarks upon its habitat and distribution are of interest: "Frequent on the branches of trees above 5,000 feet altitude; among the most rigid of all this miscellaneous group of species; uniformly found growing on the branches of trees of the high ridges to which the distribution is confined, not on the trunks as most of the other similar species do."

POLYPODIUM AROMATICUM SP. NOV.

Plant rigid, 15–20 cm. high: rhizome stout, suberect, considerably elongate, with abundant dark-brown lanceolate attenuate chaff, and bearing numerous closely set fronds imbricated much after the manner of *Elaphoglossum huacssaro*: stipes averaging 3 cm. long, dull-brownish, hispid by scattering short spinescent hairs which from their fragility early impart a tuberculate appearance: laminæ pinnate, about 13–17 cm. long, at most 4 cm. broad, erect, coriaceous, opaque, narrowly oblaceolate, giving rise rather abruptly to a terminal caudate segment 2–3 cm. long, which is subentire except at the coarsely serrate base; rachis hispid on both surfaces throughout similarly to the stipe; pinnæ about 35 pairs, distinctly alternate, linear, strongly revolute, 2–2.5 mm. broad, nearly or quite their width apart, entire, falcate, fully adnate to the blackish rachis, dilated at the upper side, the apices acute; the lower pinnæ gradually reduced, the lowermost not minute, 5–7 mm. long, extremely brittle; venation free, the distinctly black midveins

* Bull. Bot. Dept. Jamaica 4: 117. 1897.

† *Polypodium rigescens* Bory; Willdenow, Sp. Pl. 5; 183. 1810.

‡ Hooker and Greville. Icon. Fil. 2: *pl. 216.* 1831.

bearing 8–13 pairs of obscure simple oblique veins which approach the margin; sori 6–12 pairs to the pinna, borne at half the distance to the margin.

Type in the herbarium of the New York Botanical Garden; collected on Blue Mountain Peak, Jamaica, at an altitude of 1950-2225 meters by L. M. Underwood, *no. 1449*, February 11–12, 1903. There is a fragment of the type specimen in the U.S. National Herbarium, no. 428420. Other specimens to be referred to this species are: *Underwood no. 1469* and *Underwood no. 2490*, both from the summit of Blue Mountain Peak, and *Maxon no. 1346a* from the highest slopes of John Crow Peak, altitude 1650–1800 meters. There is additionally a single sheet in the Jenman herbarium.

Jamaican specimens of this species were referred by Jenman* to *Polypodium firmum* Klotzsch,† founded upon material from Chile and Guiana. They accord only indifferently with Klotzsch's description; and in any event the earlier *Polypodium firmum* of Kaulfuss,‡ applied to a very different plant from Australia, precludes use of the name.

There is a specimen in the U. S. National Herbarium no 200650, collected at Songo, Bolivia, November, 1890, by Miguel Bang no. 901 (distributed as *P. plumula*) which is identical with the Jamaican plants here described as *P. aromaticum*; and it has, moreover, after a lapse of more than ten years the peculiar aromatic odour noted in these. It may indicate a general distribution of *P. aromaticum* in South America; but whether or not it represents the *P. firmum* of Klotzsch is difficult to say. The name *Polypodium aromaticum* is founded upon Jamaican specimens and is not intended as a substitute for *P. firmum* Klotzsch. If the plants described by Klotzsch under the latter name shall prove distinct from *P. aromaticum*, they must necessarily receive a new name.

Polypodium aromaticum may be distinguished easily from *P. rigens* by its broader laminæ, by its fewer pinnæ (these linear and acute-pointed), by the absence of bristly hairs among the sporangia, and in recent specimens at least by the remarkable spicy odour of the fronds. The type specimen bears about 20 fronds. According to Jenman the species is "infrequent on the branches of trees above reach from the ground at 6,000–7,000 feet altitude in forests."

THE STORY OF THE PAPAW, IV.

By F. B. KILMER.‖

(*Concluded from Bulletin for May.*)

DIGESTIVE ACTION, (continued).

With the animal ferments, if the temperature be raised to near 140 F., there is a diminution in the digestive action, and at about

* Bull. Bot. Dept. Jamaica 4: 123. 1897.
† *Polypodium firmum* Klotzsch, Linnæ 27; 378. 1847.
‡ Kaulfuss, Wesen der Farrenkr. 100. 1827.
‖ Reprinted from the "American Journal of Pharmacy."

158 F., pancreatin is destroyed; pepsin at about 160 F. Quite the reverse is the influence upon the papaw ferments. Here the action, beginning as low as 50 or 60 F., increases slightly with the rise of temperature until between 155–160 F. it reaches the maximum. The action is not entirely destroyed even at a few moments' exposure at the boiling point. A digestive ferment active at temperatures ranging from 50 F. to the boiling point is notable.

PRODUCTS OF DIGESTION BY THE PAPAW FERMENT.

A peculiar phenomenon arises in the digestion of albumen by the papaw enzyme. It is particularly noticeable in the digestion of egg albumen in alkaline solution, but it is manifest in the digestion of raw flesh albumen in either acid, neutral or alkaline media. After every prolonged digestion there is found an undissolved residue, which many observers have characterised as an unchanged albumen, and which is usually measured as undigested residue. But such is not the case. This residue is an altered albumen; is soluble in 0·3 to 0·5 per cent. solution of sodium carbonate or 0·2 per cent. hydrochloric acid. From such solution it is reprecipitated upon neutralization, and re-dissolved by an excess of the precipitant. It is insoluble in salt solutions. Its solution in sodium carbonate upon dialysis becomes almost entirely soluble in water.

The dialysed solution noted above gives a precipitate with acetic acid and potassium ferrocyanide, but nitric acid gives no precipitate. The solution gives the ordinary proteid reactions, and apparently the whole of the proteids are reprecipitated by the addition of a large quantity of alcohol. This body is further digested after washing and treatment with a fresh solution of the ferment, and also in an acid solution of pepsin; it is almost completely digested in an alkaline solution of trypsin, yielding (as shown at one trial) the ordinary products of digestion. This body corresponds quite closely to the antialbumid found in digestions by hydrochloric acid and by trypsin.*

The products arising in the digestion of egg albumen, blood fibrin or beef albumen are quite alike either in acid, alkaline or neutral solutions, with the exception of certain slight modifications dependent upon the conditions of trial, reaction, etc. Hemialbumose (protoalbumose, deuteroalbumose and, in some instances, heteroalbumose), hemipeptone, peptone products, and the amid bodies, leucin and tyrosin, are all found in addition to the peculiar body above noted which is present only in minute amounts.

All of these bodies seemingly make their appearance in the early stages of digestion, and each one is found at the end of prolonged digestion, although under ordinary circumstances deuteroalbumose and true peptone predominate to a high degree.

* A quite similar body is found in Brometin digestion of albumen. (See Chittenden—*Journal Physiology* No. 4, 1893.) It is quite evident that this body would be re dily converted into soluble absorbable products in the digestive tract.

The close identity of the products of the action of the enzyme of the papaw and that of tryptic and pepsin digestion can be seen in the accompanying diagram :

PAPAW FERMENT DIGESTION.

Albumen.

- P. Albumose
- Hemialbumose
  - Hemipeptone
    - Leucin, Tyrosin

TRYPSIN DIGESTION.

Albumen.

- Antialbumose
  - Antipeptone
- Hemialbumose
  - Hemipeptone
    - Leucin, Tyrosin

PEPSIN DIGESTION.

Albumen.

- Antialbumose
  - Antipeptone
- Hemialbumose
  - Hemipeptone

NITROGEN IN DIGESTIVE PRODUCTS.

It is well known that the hemialbumoses and peptones formed by pepsin or trypsin show an increase of nitrogen above that of the original proteids. In the case of the ferments under consideration this is reversed ; the proteid products show a decrease in the nitrogen content. The following experiment illustrates this : The clear filtrate resulting from a prolonged digestion of egg albumin in a neutral solution, was concentrated, filtered and precipitated with alcohol, extracted with hot alcohol ; the resultant mass (consisting for the most part of peptones) was then subjected to analysis by the Kjeldahl process. The average result of three trials expressed in percentage was N, 14·14.

The following comparison with the nitrogen content of proteids will illustrate the point :—

Egg albumen... ...	...N. 16.02	Hamerstein...	...
Hemialbumose ...	...N. 16.55	... ...	...Kuhne
Soluble processes (papaw ferments) ..	...N. 14.14	(3 trials)...	...Kilmer

The action of the papaw ferments upon milk is quite identical to the action of pancreatin. There is first the act of curdling in which the casein is separated into a soft flocculent precipitate ; this is followed by a digestion of the proteids, during which process they are converted into soluble and diffusible products. The curdling takes place at ordinary temperature in neutral or alkaline reaction ; is delayed by increase of alkalinity, and hastened by increase of temperature. The digestive action proceeds independent of the act of curdling, and whether the reaction is neutral, acid or alkaline. (Best digestion is with 2 per cent. bicarbonate of soda or 25 per cent. lime water.)

In addition to the proteolytic and rennet ferments noted, and the probable presence of pectase, there is present in the papaw latex, amylolytic ferment capable of acting upon cooked starch. The amount of this starch-converting ferment is not large, or else it is weak. The fresh latex acts promptly upon starch paste, thinning it, and converting a portion at least into soluble starch and dextrin. (The amount of reducing sugar produced is slight.)

The starch-converting action of the separated ferment (or dried latex) is not very pronounced. The most that can be said is that it is present.*

Altogether we are warranted in the statement, that the digestive action of the ferments contained in the papaw latex and the products formed in such are quite identical with that of the animal and vegetable ferments in general.

* The pronounced amylolytic action of some of the papaw ferments in the market is probably due to the addition of diastase.

THE BREADFRUIT. II.*

By HENRY E. BAUM.

(*Continued from the Bulletin for July.*)

The breadfruit is a common tree in the Malay Archipelago, having its original home, according to De Candolle, in the Sunda Islands, the group having Sumatra at its western end and Timor at its eastern, or in the Moluccas, which lie to the northeast of this group. The sterile variety is to be found side by side with the seeded in this labyrinth of islands, and the tree has been reported by Rumphius as growing wild on some of the Sunda Islands. The seedless variety was, however, carried to the Pacific Islands at an early date, and when the first Europeans made their way into the South Sea it was found under cultivation on all the islands from the Malay Archipelago to the Marquesas group and from the Low Archipelago in the southern hemisphere to the Hawaiian Islands in the northern. The open-boat journeys of the Polynesians in their peopling of the Pacific islands are marvelous from the point of view of seamanship alone, but become even more wonderful when the record of their agricultural introductions is considered. Probably a hundred species of plants were introduced into Hawaii by the Polynesians, and as a majority of their principal food-producing plants were propagated by cuttings alone, the difficulty in successfully carrying them across a wide expanse of ocean in open boats is obvious.

The tree has at present, however, a cosmopolitan distribution in the tropics as the result of the introductions and care of civilized man, although it does not flourish equally in all parts of the warm portions of the earth.

As an indication of the distribution of the breadfruit in former times may be mentioned the records of its occurrence in the geological formations of Greenland and of its discovery near Denver, Colorado, while a third instance has been reported from California.

HISTORY.

While the home of the breadfruit in the Asiatic islands has never been seriously questioned, and the fact of its extensive pre-Magellanic distribution among the islands of the Pacific is undoubted, nevertheless it seems pardonable to briefly trace the growth of knowledge regarding this vegetable curiosity among Europeans.

The breadfruit was in all probability seen by the Portuguese and Dutch pioneers in the East Indies in the early years of the 16th century. But as it was obliged to compete with the spices and other marketable tropical products of the Moluccas, it did not attract sufficient attention to be noticed in the published accounts of their voyages. Although the fruit is supposed to be native in the Sunda Islands and the Moluccas, points reached by Europeans at

* Reprinted from *The Plant World*, VI., 225, Oct 1903.

an early date,* nevertheless it does not obtain there any smeblance of the importance assumed in the oceanic islands to the east, where it forms one of the principal articles of diet of thousands of natives. In the East Indies, on the other hand, it is over shadowed by a long series of quicker growing and better tasting sfood products.

Turning to the Spanish and English voyages from the east it is interesting to note the absence of mention of the breadfruit in the journal of the Chevalier Pigafetta,† who accompanied Magellan during the first circumnavigation of the world. Guam, in the Marianne Islands, was visited during this voyage. They observed in the canoes of the natives various products, such as coconuts, bananas, etc., common to the Pacific, but no breadfruit. Drake, the second circumnavigator, visited the same group, but did not touch at Guam. He likewise failed to report seeing the fruit, as did also Cavendish, the next to essay circling the globe. From a study of the various accounts of these voyages, however, it may be ascertained that in all three cases the visit was made during the months in which the fruit is not in season in that group.

The records of the early voyages of the Spaniards across the Pacific from New Spain to Asia are largely traditional, although fairly well authenticated by circumstantial evidence. It is not, however, until 1567, with Mendana's discovery of the Solomon Islands, that we can begin to trace with any accuracy the voyages into that mysterious waste of waters. A full account of this first attempt to discover lands in the Pacific would mean a review of Peruvian folk-lore in which the natives had kept alive traditions of inhabited islands to the west,‡ and also follow the adventurers on their sail of 3,000 miles to the Solomons. No notice of the breadfruit was made there, but on their way home a low coral island, probably an outlying northern member of the Marshall group, was visited, the Spaniards finding "some of the natives' food, which was very different from those of the islands [Solomons], and of a bad taste and smell." That this native food was the breadfruit is extremely likely, judging from negative evidence; but on the other hand it is just as probable that it was the fruit of the screw-pine (Pandanus) fermented in underground pits. The Pandanus tree is extremely common on the low coral islands of the western Pacific, where it apparently grows without human aid, and

*Between 1505-9 an Italian traveller, Varthema, is supposed to have reached the Moluccas and to have told, while on his way back to Europe, the great Indian Viceroy of Portugal, D'Albuerque, of the riches of Ternate and Tidor. In consequence of this information Antonio d'Abren was despatched in 1511 to reduce these islands to the commercial domination of the Portuguese trader. This expedition was not immediately followed up, and the Spaniards and Dutch found their way to the Spice Islands in time to enter rival claims for possession. The Dutch, however, by persistence and good management got the upper hand, and by the end of the 17th century were the undisputed masters of these fruitful islands.

† "The First Voyage Around the World by Magellan" (Hakluyt Soc. Ed). London, 1874.

‡ "The Discovery of the Solomon Islands by Alvaro de Mendana in 1568" (Hakluyt Soc. Ed). Introd., pp. iv. v. London, 1901.

which, together with the coconut, forms the chief source of food supply of the coral islanders.

Ferdinand de Quiros, who sailed as chief pilot with Mendana in 1595, when that adventurer attempted to colonize his islands of Solomon which he had discovered over a quarter of a century before, noted the breadfruit growing on the island of Santa Christina or Tauta in the Marquesas group. This group of islands was first made known to Europeans through this expedition, and in the harbour of Madre de Dios, Quiros observed the natives and made notes on their food supplies, the following being the first account of the fruit which can be identified with certainty :

"A fruit growing on large trees, each fruit about the size of a large pine-apple. It is a very good fruit. I have eaten much of it green, roasted and boiled, and ripe. It is so sweet and good a fruit that, in my opinion, there is none superior, having nothing to throw away but a little shell." *

A letter from Quiros to Don Antonio de Morga, Lt.-General of the Philippines, is the principal source of information regarding this voyage upon which the Spanish chroniclers draw for their leading facts. Figueroa, however, seems to have talked with companions of Quiros and Mendana, as on particular points he is considerably more detailed, but unfortunately for the history of this voyage only a fragment of his work is to be found. His version is as follows :

"The trees, mentioned to be in the square, yield a certain fruit which comes to be like the head of a boy, whose colour, when ripe is a clear green, and extremely green when unripe; the outside appears with cross rays, like the pine-apple; the figure is not quite round, it is somewhat narrower at the point than at the foot;† from hence grows a core, which reaches to the middle, and from this core a web. It has no stone or kernel, not anything useless, except the outside, and it is thin, the rest is one mass, with little juice when ripe, and less when green. Much were eaten in every way. It is so delicious that they called it *blanc manger*. It was found to be wholesome and very nourishing. The leaves of its trees are large and very jagged, in the manner of papays."

A search through the later literature of Spanish travel would no doubt bring to light many interesting historical references, but with the beginnings of English naval supremacy in the Elizabethan era her navigators began to play a more important part in the work of exploring the Pacific, and to them the later developments in the history of the breadfruit can largely be traced. The first Englishman to report the fruit was Captain Wm. Dampier, who in 1686

*A. Dalrymple, "Historical Collection of Voyages and Discoveries in the South Pacific Ocean;" Vol. 1. p. 70 London, 1770.

†This peculiar ob-pyriform fruit is figured by Captain David Porter, of naval fame, who visited these islands in 1814, during the war of the States with England, in the ship *Essex*, afterwards lost in Valparaiso Harbour The coincidence of resemblance in form is striking and goes far toward proving the accuracy of the old chronicler.

visited Guam during the fruiting season. Dampier describes the fruit and the native methods of preparing it for food and remarks that it is about the size of a penny loaf when wheat is five shillings the bushel." Nearly fifty years later Lord Anson visited the same island and reported that the fruit was about the size of a twopenny loaf, from which statement Hooker reasons that wheat had risen considerably in price since Dampier's time. Both of these explorers were highly pleased with its quality and commented upon its usefulness as a food staple to the islanders.

Geographical knowledge made great strides during the 17th and 18th centuries through the work of the explorers who were looking for gold, spices, and other marketable tropical products, and who incidentally made known to the world many an unknown group of islands.

The work of Captain James Cook in charting the then "Unknown Ocean" between 1768 and 1779, the last the date of his untimely death on the Sandwich Islands, is phenomenal when viewed merely from a geographical point of view, but his services become even more valuable when his influence on subsequent voyages and general work in the Pacific is considered. Cook fully appreciated the possibilities inherent in the breadfruit and lost no time in advertising its virtues to the English nation and in suggesting its introduction into the West Indies. During his second voyage (1772-1775) the two Forsters, father and son, accompanied the expedition as naturalists, and as a result of their collections gave the scientific name *Artocarpus communis* to the breadfruit. The published accounts of these three trips met with great popular demand, nda principally through his glowing accounts, together with the praises of the other Pacific navigators, a desire for the introduction of the fruit into the West Indies was built up, a demand which it was attempted to gratify in 1787, when Captain Wm. Bligh was dispatched to bring plants from Tahiti to the British West Indies.

In 1769, however, the French authorities had sent out from the Isle de France, the modern Mauritius, an expedition for the purpose of obtaining valuable foods and fruits for the French Insular colonies. This expedition, which carried Sonnerat, a naturalist, visited New Guinea and the Philippines, and from the Island of Luzon he shipped breadfruits which were taken back to the "Isle de France." That these plants were of the seeded variety would seem to be well indicated by the description which he gives of them in his book as well as by the figure engraved in the same work.*

The presence of the seeded breadfruit in Mauritius might be questioned, however, owing to the fact that Baker and other modern botanical writers do not mention it. That it was carried there by this expedition is hardly to be doubted, and its presence in 1789 at least is assured by an entry in a manuscript catalogue of the Royal Gardens at Port Louis, referred to in Lamarck's "Ency-

* Sonnerat, "Voyage a la Nouvelle Guinee," p. 100. Paris, 1776.

clopēdie Methodique" (3 : 208). Moreover, in the Transactions of the Society of Arts (20 : 313. 1802), there is a record of an introduction of the seeded fruit from Martinique into Tobago, and the statement is further made that the seeded fruits in the possession of the French were the result of an importation from the Isle of France in 1792.

Beginning with the year of Captain Cook's death (1779) the "Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce," offered a yearly prize for the successful introduction of the breadfruit "into the islands of the West Indies, subject to the Crown of Great Britain." This premium repeated year after year sustained the popular interest first aroused by the writings of the Pacific navigators, and this, together with the demand for the fruit among the West Indian planters themselves, caused the English Crown in 1787 to dispatch Captain Wm. Bligh in the *Bounty* to attempt the introduction of the fruit into the Western world. The interesting history of this voyage is known to most every one; the delightful stay at Tahiti in the land of summer and plenty proved to be too tempting for Bligh's crew, a mutiny resulting shortly after their departure from the romantic island. Bligh with eighteen companions was cast a drift in an open boat, poorly provisioned and equipped, near the island of Tofoa in the Tonga group. Meeting with a hostile reception from the natives of that island, they were obliged to steer for the distant East Indies, fearing to land on the Oceanic islands on account of their defenseless condition. After one of the most remarkable open-boat voyages in the history of navigation they reached Timor, and as Bligh remarks—

"It appeared scarcely credible to ourselves that, in an open boat and so poorly provided, we should have been able to reach the coast of Timor in forty-one days after leaving Tofoa, having in that time run, by our log, a distance of 3,618 miles; and that, notwithstanding our extreme distress, no one should have perished in the voyage."

The mutineers sailed back to Tahita and from thence some of the Englishmen, accompanied by Tahitian natives, migrated to Pitcairn's Island, where, after the death of all but one of the Europeans, under the leadership of the reformed mutineer one of the most ideal communities in the world was developed.

Nothing daunted by the misfortune of their first attempt, the English Government, stimulated by Sir Joseph Banks, President of the Royal Academy, and one of the naturalists of Captain Cook's first voyage, sent Bligh in 1792 to make another attempt. This time all went well, and in 1792 approximately 700 plants were divided among the islands of St. Helena, St. Vincent, and Jamaica, the two last mentioned receiving the lion's share, while a number were taken to the Kew Gardens for hot-house growth.

The estimate put upon the fruit by those concerned in its introduction is well shown by the following quotation:

"At length their wishes have been happily gratified by the persevering attention of Captain William Bligh, assisted by those ingenious botanists Mr. William Wiles and Mr. Christopher Smith, whose names on this occasion ought also to be recorded, and the Western world put in possession of what will hereafter secure to that part of the globe an inexhaustible fund of good, palatable, and wholesome food."*

Bryan Edwards, the historian of the West Indies, had remarkable ideas of its utility, very interesting in the light of its subsequent history in those islands: "The cultivation of these valuable exotics will, without doubt, in a course of years, lessen the dependence of the sugar islands on North America for food and necessaries; and not only supply subsistence for future generations, but probably furnish fresh incitements to industry, new improvements in the arts, and new subjects of commerce."

As an illustration of carelessness in the treatment of the history of the breadfruit the records of its introduction into the West Indies may be cited. In practically all the available literature discussing this point, the first introduction has been assigned to Captain Bligh with the date 1793. As this navigator brought an overwhelming majority of seedless plants, the existence of the seeded variety in the West Indies has been somewhat of a mystery, some even going so far as to suggest a reversion to the primitive type by the sterile fruits, with the consequent formation of seeds. The reversion theory is hardly tenable, however, when we find printed records of the seeded variety antedating 1793. Bligh, moreover, in claiming the reward of the Society of Arts for his feat made an affidavit stating that but one seeded plant (from Timor) was secured by him. The proportion is thus so small, one to seven hundred, that it is obviously inadequate to populate the West Indies even if the records of the seeded sort before 1793 had not been found.

Tussac, however, in his monumental "Flora des Antilles," buried nearly a hundred years ago the fact that Lord Rodney in 1782† was instrumental in introducing the seeded breadfruit into Jamaica. The fortunes of war had that year thrown into his hands a French vessel laden with useful plants of the East Indies destined for the French West Indian Colonies. In a list of the plants growing in the gardens of Hinton East in Jamaica, Bryan Edwards gives the Jak alone as being introduced by Lord Rodney, while Tussac credits the same sailor with the introduction of both the Jak and breadfruit. The famous No. 11 mango was also one of the horticultural spoils of this ship, which was captured while en route between Mauritius and Santo Domingo. These vegetable aristocrats were intended for the French colonists in Santo Domingo, but were strangely enough enjoyed by her greatest rival, England. Before 1792, however, according to a record in the transactions of the

* Preface, Vol. 12, Trans. Soc. Arts, p. xiii.

† Sagot (*Journ. Cent. d'Hort de France,* 2 ser. 6: 38; 1872) also records this introduction of the seeded fruit, presumably after Tussac.

Society of Arts, the French successfully introduced the seeded variety into Martinique, as in that year Mr. Robley, the Governor of Tobago, imported from the French Island plants which he grew with the understanding that they were of the seedless variety, but was greatly disappointed when they turned out to be full of seeds and consequently worthless, according to his light. These introductions, however, occasioned but little notice, and when Captain Bligh in 1793 successfully brought the Tahiti fruit he was universally given the credit for the first introduction. It may be that the presence of the inferior seeded kind was the cause of the English in those islands petitioning for the importation of the true or seedless breadfruit, whose utility they were just beginning to appreciate through contact with the writings of Dampier, Anson, Byron, and Cook.

(*To be continued.*)

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE. II.*

(*Continued from Bulletin for July.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

IMPROVEMENT OF RUBBER TREES BY SELECTION.

Instead of being able to dispense with agricultural knowledge, skill, and caution, the rubber planter needs an extra supply of these, since, without the advantage of adequate experience, he has the added responsibility of choosing favourable natural conditions, applying correct cultural methods, and securing the plants most suitable for the circumstances under which he must operate. That American planters have given their attention so exclusively to Castilloa, and those of the East Indies to Hevea, is not the result of any demonstration of the cultural superiority of the one tree or the other, and the desirability of many other species reported as promising remains to be determined. It is entirely possible that that no one species will be found to have a superior value under all conditions and be planted to the exclusion of all others. Rubber, like starch, is produced in nature under varied conditions, ranging between deserts and swamps. The number of cultivated rubber plants will probably never equal that of the starchy cereals and root crops; but there is the same practical reason why the cultural requirements, hardiness, vigour, and productiveness of the different rubber plants should be considered, and not merely those of the distinct genera and species, but those also of the differing varieties or races into which each species will be found divisible by cultural selection.

It has been found possible with many plants to increase the average percentage of starch, sugar, or oil through the planting of

* Extracts from U. S. Department of Agriculture, Bull. No. 49, Bureau of Plant Industry.

selected seed or cuttings, and there is every probability that the same will be true of rubber. In fact, the great variation in the amount of rubber both in wild and in cultivated trees is itself an indication that a ready response to selection may be expected The selective improvement of trees propagated from seed is, however, a very slow process, owing to the time required to bring the generations to seed-bearing maturity. With Castilloa much more prompt results could be obtained by the use of cuttings made, of course, from true or permanent branches. It would be excellent policy on the part of planters to set as large a part of their plantations as possible with cuttings from their most productive trees, and to watch for the best "milkers" in each generation, just as the sugar growers test the sugar content of individual canes and of individual beets which are to be used for propagation. The selective improvement of rubber plants may be pushed forward without waiting to find out what the function of rubber is or what determines its formation in the plant, since all that the planter needs to know is that rubber is present in more than average quantity in certain of his trees, and he may expect that by propagating from these under the same conditions a higher average of production may be secured.

PROBLEMS PRESENTED BY THE LATEX, OR "MILK."

Of what use is the rubber milk to the trees, or why do the trees make rubber? These are the questions which seem to underlie the scientific investigation of the cultural production of rubber. At first it was taken for granted that the elaboration of rubber is the special function of the rubber tree, an idea apparently indorsed by some of the tree-planting companies in such statements as the following:—

> You can no more grow a rubber tree without the rubbber milk in it than you can grow a sugar-maple tree without the sugar sap in it. The growing of rubber trees in their own soil and climate is just as practical, just as safe, and just as sure as gathering elm seed and growing elm trees therefrom.

Rubber is not, however, the fruit of the rubber tree, except in the financial and commercial sense, and even the slightest experience in Agriculture should have prevented the inference that because a plant thrives when young it is certain to reach a productive maturity. Many of the early experimenters in rubber culture have found to their cost that the Central Americrn rubber tree, at least, can grow with the most promising vigour and yet fail to deliver any approximation of the estimated quantities of gum. Indeed, this fact might have been learned with vastly less expense of time and money by consulting the native rubber gatherers, who are thoroughly aware that many "ule" trees give no return for tapping. The realization of this simple and fundamentally important fact has been delayed through existence in some of the Central American rubber districts of a second species of Castilloa," called by the natives "ule macho," or "male rubber," because it gives little or no milk.

Possibly owing to the suggestion of the obviously distinct sexes of the tropical papaw, or melon tree, the idea of sexuality in plants is widely prevalent among the aborigines of tropical America and their Spanish-speaking descendants, who thus have in the word "macho" a ready explanation of unproductiveness.

Perhaps it has never occurred to any of the native rubber gatherers to insist that the white man should understand the difference between the *"ule macho,"* which is a distinct species (*Castilloa tunu*), and the *"ule"* termed *"macho,"* because it does not yield milk, though not in other respects different from the productive trees. Again has a little learning proved dangerous, in that the existence of a sterile species of Castilloa has served as a general explanation of differing yields of rubber, the true causes of which still remain to be discovered.

That varietal and individual differences of yield will be found inside the genuine rubber-producing species is, of course, to be expected, but there is also every probability that conditions, whether natural or artificial, may have a profound influence on the all-important feature of rubber production, so that we are brought again to our original question of causes determining the formation of rubber.

EVOLUTIONARY ARGUMENTS REGARDING LATEX.

Some have insisted that the solution of the problem lies is discovering the use of the rubber to the tree, on the ground that natural selection brings into existence only useful characteristics. This theory has encouraged speculation, and numerous attempts have been made to frame a general explanation of the function of latex, or milky juice in plants. Such, however, is the diversity both of the thousands of latex-producing plants and of the substances which the various kinds of milk contain, that any explanation sufficiently general to accommodate all might have little practical bearing on rubber culture. Indeed, there is no assurance of unity of causes and methods of formation of milk in the several hundred species of rubber-producing plants of diverse families and conditions of growth, and we can even go further and say that Castilloa itself demonstrates that the production of milk and of rubber may be of no very serious importance in the plant economy, since apparently normal growth and reproduction are accomplished with little or no rubber. Furthermore, we have no assurance that the discovery of the function of the latex would bear directly upon the question of rubber production, since it does not appear that the mechanical qualities which we value in rubber, notably its elasticity and toughness, are of use to the tree or that they exist in the living latex. Commercial rubber is certainly a very different substance from the creamy mass which first appears when coagulation sets in, and numerous changes may have taken place before even this stage is reached. Between the vegetable and animal milk no complete analogy can be maintained, but it serves to illustrate the present point if we think of the rubber not as the curd

which coagulates from the milk, but as the butter which may be separated both from the curd and from the still more watery constituents of the milk. As the churned butter is different, both mechanically and otherwise, from the fat globules floating in the milk, so does rubber differ, and probably to an even greater extent from the semifluid globules of the latex emulsion. Rubber, as such, has no function in the plant, and there is nothing to indicate that the qualities which make it valuable to us are of any significance in the vegetable economy. Furthermore, it appears that at different stages of the Castilloa tree, and even in different parts of the same tree, the substance which becomes rubber may be replaced by another, which hardens with exposure into a worthless, nonelastic resin; indeed, resin and not rubber is a constituent of the latex of the numerous relatives of the rubber-producing trees.* It appears, then, that to trace any direct connection between rubber and the economy of the tree is likely to be very difficult, if not quite impossible and in general reasoning on the subject the inquirer must be content to learn, if possible, the causes which influence the quality and quantity of latex in trees known to produce rubber.

FUNCTIONS ASCRIBED TO LATEX.

The nature and functions of latex in plants are difficult problems. Many dissertations have been contributed to swell the experimental and controversial literature of the subject. Many interesting details have been discovered regarding many lactiferous plants, and many suggestions and theories have been contributed to the subject of plant physiology, but thus far no very practical result seems to have been reached in this direction. Indeed, progress may have been impeded by the idea that it is necessary to postpone the investigation of concrete problems of rubber production until a general theory of the function of latex or milky juice in plants can be formed. Very different suggestions regarding the uses of latex have been defended by different investigators on the basis of studies of different plants. The first observer compared them to the blood of animals and described the globules of gum as corpuscles, a highly fanciful notion which later writers have so zealously disavowed that they have felt it necessary to deny any circulation at all. Some have held that the milk tubes are reservoirs for the storage of elaborated food materials, while others believe that latex is an excretory or waste product, even to the proteids, starch, and sugar with which the milky fluid is commonly charged. Protection against insects and snails has also been urged as the function of latex. One of the most recent writers on the subject† reviews and dismisses all the previous suggestions apparently for the reason that none is of general validity and, after

*In the State of Vera Cruz, Mexico, grows a large-leaved species of Ficus, the milk of which coagulates promptly into an elastic substance like true rubber but the elasticity soon disappears when the gum is exposed to the air and repeatedly stretched between the fingers.

†Percy Groom on the Function of Laticiferous Tubes, Annal of Botany 3: 157, 1898.

detailing numerous observations of his own, comes to the following disappointing conclusions:

It seems impossible to discover what is their function or to ascertain if there is one function common to all laticiferous tubes until microchemical methods are vastly improved or until analyses of latex in its various stages are made.

Obviously, however, there is no reason why it must be believed that all the functions of all milk tubes are the same, or why one function should exclude another. That insects, such as leaf-cutting ants, should not be able to attack rubber trees because the gum would disable their mouth parts might be an important advantage in central America, but would not explain rubber in African plants not subject to the depredations of these insects. The most that can be done is to learn the uses of latex in one plant at a time, without anxiety as to whether or not a general function for latex in all plants will be discovered.

THE STRUCTURE OF LATEX.

All the foregoing suggestions and many others seem to have been made before it occurred to anybody to treat the simple but fundamental question of how the rubber is formed in the milk-bearing tubes. But there is one author at last who has appreciated this point and who has discovered by a close microscopical examination of the rubber globules that each is surrounded by a thin coating of protoplasm, with a small nucleus on one side.* This means that the globules of rubber are produced in the same manner as globules of fat and resin, and like the granules of starch and the crystals of lime, oxalic acid, and other substances which are laid down by the protoplasm of plant cells. If the rubber appeared in the tubes merely by chemical action or because the constituent elements were brought together, this would be an indication favourable to the synthetic production of rubber in the chemical laboratory, and it would mean also that the milk is, if not a solution of rubber, at least a solution of the constituents of rubber.

There are, however, no observations to indicate that rubber exists in plants except in the form of minute globules, so that the milk resembles that of the cow in being an emulsion. The globules are not, however, naked and free, but each is surrounded by a layer of protoplasm which must contribute a part of the "albuminous constituents" of the latex if it does not supply all, though this does not make it easier to understand the recent statement of Dr. C. O. Weber† that such materials are not coagulated by boiling. It might be thought that the boiling coagulates the protoplasm of each globule separately and that the rubber is released afterwards and rises to the top, but Dr. Weber's statements would not bear this interpretation, though the absence of an explanation of the supposed failure of heat to coagulate any of the albuminous matter leaves the impression that this account of the details is not complete.

(*To be continued.*)

* Studien über den Milchsaft und Schleimsaft der Pflanzen, von Prof. Dr. Hans Molisch. Jena, 1901.

† Tropical Agriculturist, 22:443, January, 1903.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. SEPTEMBER, 1904. Part 9.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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KINGSTON, JAMAICA:
HOPE GARDENS.

1904.

JAMAICA.

BULLETIN

OF THE

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Vol. II. SEPTEMBER. 1904. Part 9.

THE AGRICULTURAL BASIS OF THE CASSAVA INDUSTRY.

By H. H. COUSINS, M.A., F.C.S., Island Chemist.

Cost of Cultivation.—There are two points from which this may be estimated -

(1.) That of a planter who already possesses lands and a planting establishment capable of being devoted to Cassava in preference to another crop or in addition thereto.

(2.) That of an Agriculturist who intends to invest in Cassava cultivation by growing it upon ruinate lands, at present uncultivated and involving a considerable outlay of capital in buildings, live and dead stock and in general improvements to the holding to fit it for cultivation.

The data from Longville, from Hope Gardens and from Little River in St. James come under the first category, while data from the Hon. H. Cork, and the Hon. J. V. Calder refer to the second type of conditions.

Cost at Longville.—The figures obtained by Mr. W. J. Thompson from Mr. Middleton's manager showed that on this property the cost of growing and reaping an acre of Cassava was £4. This represents the actual out of pocket expenses of Cassava grown upon cultivated lands and omits all charges such as rent, management and interest on capital.

Cost at Hope Gardens.—The actual cost at Hope of an acre of Cassava, if the extra cost of making hills be omitted as unnecessary for broad scale culture, has been found to be £4 11s. 4d. per acre. St. Andrew is an expensive parish for labour and these figures should cover the actual cultivation expenses of Cassava in most parts of Jamaica.

Little River, St. James.—Mr. Shore finds that Cassava can be

grown in this district by hand labour on rocky land that can grow little else than guinea grass and is quite unsuitable for canes, at a total cost of £5 per acre including growing and reaping.

Hon. H. Cork's estimate.—Based upon implemental culture on a 100 acre scale and exclusive of all capitalised charges. This estimate from a planter of wide experience of cultivation in Jamaica, indicates a cost of £3 13s. 0d. to £5 2s. 0d. per acre as a minimum and a maximum respectively.

Allowing 10 per cent. on capital and 20 per cent. on live and dead stock account the total capitalised cost of growing cassava on uncleared land, on a large scale, is estimated by Mr. Cork at £5 18s. 0d. to £7 19s. 0d., per acre—say £6 to £8.

This estimate indicates that to start 100 acres of cassava as a self-contained industry on new land, a capital £1,600 to £2,000 would be required, while the actual cost per acre would be as given above, viz. £6 to £8.

The Hon. J. V. Calder estimates a rental charge of £1 per acre and £1 for management. Mr. Cork's estimate, based upon a fully detailed account, closely corresponds to this viz. 45s. per acre. It is satisfactory to find two estimates based the one upon general experience and the other on actual details and cost, to agree so closely.

Summary.—Cassava should cost—for cultivation only—£3 13s. to £5 2s. per acre according to locality, and circumstances. Rent, interest and management are excluded from this estimate.

The lower price represents the estimated cost under the most favourable conditions of broad-scale implemental culture, the higher that of hand labour in rocky land by small cultivators—Cassava Farming in short.

An average of £4 per acre represents the estimated cost under favourable conditions of estate cultivation.

Yield per acre.—The data from Longville showed that yields of 6 to 8 tons of tubers were there obtained under somewhat unfavourable conditions.

Mr. Shore gives 8 tons as an average return from Little River lands and states that he knows lands that give more.

On the other hand, Mr. Calder sounds a note of warning that he found when growing Cassava in St. Elizabeth that it took 18 months to produce 5 tons per acre. Only experience and local experience can settle this crucial point of the agricultural yield of Cassava.

If we can maintain an 8 ton standard, Cassava would be a very profitable crop, if on the other hand the yield should only be 4 tons per acre the results would not be remarkable.

Profit—This depends upon the yield and again upon the price obtainable for the product. I have estimated that an 8 ton crop of cassava giving 5 tons dry meal for shipment to England to glucose makers would yield a profit of £700 to £900 upon a scale of 100 acres. Selling tubers to a starch factory at £2 per ton would mean a profit of £8 to £10 per acre on the same basis.

THE CULTIVATED SOILS OF JAMAICA *(continued.)**

By H. H. COUSINS, M.A., F.C.S., Island Chemist.

COFFEE (Blue Mountains.)

This soil represents an average sample of the lands at an elevation of 3,000 to 4,000 feet in the Blue Mountains upon which the best coffee in the world is produced. The fertility of these lands is mainly supported by the continuous supply of fresh material from the upper areas of the Mountains. The stability of the fine soil is greatly promoted by the stony nature of the surface soil of which about $\frac{3}{4}$ consists of coarse stones and the remainder of fine soil showing a very high standard of fertility on analysis. It is not reasonable to expect that commercial fertilisers could be either effective or profitable upon a soil of such a special character as this.

SOIL ANALYSIS.

Reference Number—91.
Source Details—Soil from Blue Mountain Coffee Estate.
Depth of Sample—9 inches.

Physical Analysis.

			Per Cent.	
	Stones	...	72 83	
	Gravel	...	43·12	Fine Earth.
	Sand	...	6·61	
	Fine Sand	...	17·64	
	Silt	...	21·29	
Agricultural Clay.	Fine Silt	...	6·66	
	Clay	...	0·73	
	Moisture	...	3·95	
		Total	100·00	
			Per Cent.	
Retentive Power for water		...	56·	

Chemical Analysis.

(Soil passed through 3 m.m. sieve dried at 100° C.)

Insoluble Matter	...	51·48
Soluble in Hydrochloric Acid		48·52
Potash		0·297
Lime		1·83
Phosphoric Acid		0·168
Carbonic Acid as Carbonate of Lime		0·690
Combined Water and organic matter		19 92
Humus (soluble in Ammonia)		6 83
Nitrogen		0 52
Hygroscopic Moisture		4·11

Fertility Analysis.

Available Potash	...	0 0143
Available Phosphoric Acid		0·0318

* For previous reports on Jamaica Soils, see The Banana Soils of Jamaica: Bull. Bot. Dept., VIII, Oct., 1901, p 145; and Bull. Dept. Agri., I, Jan., 1903, p. 1. The Sugar Cane Soils of Jamaica: Bull. Dept. Agri., I, Apr., 1903, p. 76; and I, May, 1903, p. 97.

Observations.

This soil contains a high proportion of stones, the fine soil upon which the roots of plants would mainly feed contains much coarse gravel and a preponderance of fine sand and silt with a fair proportion of agricultural clay. This soil is specially adapted for steep lands as the fine soil is held in pockets by the coarser grades and stones and is thereby protected from severe washing and denudation.

The chemical analysis of the fine soil indicates a fertility above par in every respect. The nitrogen, humus and phosphoric acid are all very high and the potash and carbonate of lime up to a good standard. A soil of very high quality for coffee cultivation at a high elevation. I am of opinion that commercial fertilisers are not needed on this land.

SUMATRA TOBACCO.

(under shade.)

A small area ($\frac{1}{4}$ acre) of land having been devoted at the Hope Experiment Station to the cultivation of Sumatra Tobacco under artificial shade, samples of the soil were taken for analysis.

The leaf developed in a very favourable manner and a crop of a promising quality of Sumatra leaf was successfully grown. Owing to the excessive rapidity of drying under the arid conditions of the Liguanea Plain and in the absence of special means for controlling moisture in the drying house, the leaf was not successfully cured and a repetition of the experiment is now in hand with a view to a better control of the processes of curing and drying.

The soil upon the experimental area showed some appreciable variation in texture and two samples representing the 'stiff' and 'light' portions of the land were taken for analysis. The results show that there is not much difference between the two samples except in the grading of the alluvial material of which the soil is composed. For purposes of comparison the physical analysis of a typical wrapper tobacco soil from the Connecticut Valley is set forth.

Physical Analysis.

	Constituents.	Hope Soil Stiff.	Hope Soil Light.	Connecticut Valley.
	Gravel .	1·27	2·92	1·05
	Sand .	0·91	2·59	5 03
	Fine Sand .	11·51	20·50	18·31
	Silt	71 54	62 47	57 94
Agricultural Clay.	Fine Silt	10·86	8·52	12 45
	Clay	0 48	0 30	2 51
	Moisture .	3·43	2·70	0·46

The soil at Hope has less clay than the Connecticut soil.

"The percentage of clay in the soil has a marked effect upon the colour and texture of the wrappers. The yield per acre is less than on the heavier soils, but the crop brings a better price per pound—(growing Sumatra Tobacco under shade in the Connecticut Valley. p. 5. U.S. Bureau of Soils.)"

We have had experimental verification of this conclusion at Hope—our yield per acre was somewhat less than that recorded from the Connecticut experiments but a leaf of a very fine texture was produced. There are large areas in Jamaica where land suitable for Sumatra Tobacco under shade is obtainable. The problem is that of the drying and curing. On the whole, it would appear that we are quite able to produce Sumatra leaf of the highest quality in the field by the use of shading. The analyses indicate that the Hope soil is of excellent fertility. The carbonate of lime is low and a dressing of marl should prove of marked benefit.

SOIL ANALYSIS.

Reference Number—92.
Source Details—Hope. Tobacco Land. "Stiff" soil.
Depth of Sample—9 inches.

Physical Analysis.

		Per Cent.	
	Stones ...	Nil	
	Gravel ...	1 27	Fine Earth.
	Sand ...	0·91	
	Fine Sand ...	11·51	
	Silt ...	71·54	
Agricultural Clay.	Fine Silt ...	10·86	
	Clay ...	0·48	
	Moisture ...	3·43	
	Total	100·00	

	Per Cent.
Retentive power for water ...	56·

Chemical Analysis.

(Soil passed through 3 m.m. Sieve dried at 100° C.)

Insoluble Matter ...	69·69
Soluble in Hydrochloric Acid	30·31
Potash ...	0·993
Lime ...	0·603
Phosphoric Acid	0·0928
Carbonic Acid as Carbonate of Lime	0·137
Combined Water and organic matter	9·21
Humus (soluble in Ammonia)	2·423
Nitrogen	0·174
Hygroscopic Moisture	3·55

Fertility Analysis.

Available Potash ...	0·0094
Available Phosphoric Acid ...	0·0370

SOIL ANALYSIS.

Reference Number—93.
Source Details—Hope Tobacco Land. "Light" soil.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

			Per Cent.	
	Stones	...	—	Fine Earth.
	Gravel	...	2·92	
	Sand	...	2 59	
	Fine Sand		20·50	
	Silt	...	62 47	
Agricultural Clay.	Fine Silt	...	8·52	
	Clay	...	0·30	
	Moisture		2·70	
		Total	100·00	
			Per Cent.	
Retentive Power for water		...	53 5	

CHEMICAL ANALYSIS.

Soil passed through 3 m m Sieve dried at 100° C.)	
Insoluble Matter ...	70·17
Soluble in Hydrochloric Acid	29·83
Potash ...	0·713
Lime ...	0·539
Phosphoric Acid ...	0·105
Carbonic Acid as Carbonate of Lime	0·0397
Combined Water and organic matter	8 03
Humus (soluble in Ammonia)	1.55
Nitrogen	0·144
Hygroscopic Moisture	2·77

FERTILITY ANALYSIS.

Available Potash ...	0.0110
Available Phosphoric Acid ...	0 0408

BANANAS.

St. Mary's.

TRINITY, Port Maria—Hon. Dr. J. Pringle, C. M. G.

This soil represents the flat low-lying area of this well-known property adjacent to the town of Port Maria and very little above the sea-level. Such a soil is often spoken of as a "clay" by local planters. The physical analysis shows it to be mainly "silt" with only a small proportion of actual "clay." Given an effective drainage system, this is a soil admirably suited for Bananas. It is obviously retentive but is by no means impervious and the Banana roots should readily permeate such a soil provided good aëration is ensured. The practical difficulty lies in the small fall to the sea-level and the necessity for a deep drainage system to secure conditions favourable to the free growth of the Bananas.

The chemical analysis shows a high standard of fertility. There is abundance of carbonate of lime; potash, phosphoric acid and nitrogen are all of a good standard.

Manurial experiments are being carried out to test the effect of commercial fertilisers. Four plots of 1½ acres each are under treatment. On general lines, I am of opinion that humus and drainage are the only problems to be faced in the field management of this splendid stretch of land.

SOIL ANALYSIS.

Reference Number—94.
Source Details—Trinity—Flat Banana Land.
Depth of Sample—9 inches.

PHYSICAL ANALYSIS.

		Per Cent.	
	Stones ...	—	
	Gravel ...	—	
	Sand ...	0·38	Fine Earth.
	Fine Sand ...	1·69	
	Silt ...	83·55	
Agricultural Clay	Fine Silt ...	4·56	
	Clay ...	0·45	
	Moisture ..	9·37	
	Total ...	100·00	

	Per Cent.
Retentive power for water ...	66·

CHEMICAL ANALYSIS.

(Soil passed through 3 m. m. Sieve dried at 100° C.)

Insoluble Matter ...	53·76
Soluble in Hydrochloric acid	46·24
Potash ...	0·0756
Lime ...	7·90
Phosphoric Acid ...	0·158
Carbonic Acid as Carbonate of Lime	11·76
Combined water and organic matter	16·40
Humus (soluble in Ammonia)	1·60
Nitrogen ...	0·182
Hygroscopic Moisture	10·34

FERTILITY ANALYSIS.

Available Potash ...	0·0110
Available Phosphoric Acid ...	0·0374

VERE.

The proprietor of a sugar estate in Vere is desirous of starting banana cultivation now that irrigation has been established. Soil samples representative of (a) the general cultivable area (b) stiff lands and (c. and d.) two well defined areas of inferior productive power, termed "gall A." and "gall B." respectively, have been analysed.

I am of opinion that owing to the heavy nature of the soil, banana cultivation will be somewhat difficult and considerable expenditure on drainage will be necessary. The available mineral fertility is high, but the carbonate of lime is very low and the soil is in rather poor condition as regards humus and nitrogen.

It would appear desirable to establish drains at least 3 feet deep, to apply a good dressing of marl and to use every means of increasing the humus in the soil by green dressings and applications of pen manure and green refuse. I do not think the soil requires help from any form of commercial fertiliser.

This is good land for sugar-cane but naturally unsuitable for bananas and requiring special treatment to make it fit for the successful growth of the latter crop.

Comparison of Soils from Vere.

Physical Analysis.

Constituents.	Caswell Hill, Vere Bananas.	St. Catherine Bananas.	Vere Estate, 'general' Soil.	Vere 1, Subsoil.	Vere 2, 'clay' Soil.	Vere 2, Subsoil.	Vere 3, gall 'A' Soil.	Vere 3, Subsoil.	Vere 4, gall 'B' Soil.	Vere 4, Subsoil.
Gravel ...	0·56	1.60	0 23	0·28	0·23	0·2	0·37	0·25	0 31	0·20
Sand ...	1·59	8.67	0·33	0·39	0·34	0·27	0·50	0·35	0·57	0·27
Fine Sand ...	11·35	40·44	14·49	1 87	1·47	0·55	2·09	0·95	11·67	0·55
Silt ..	71·05	43·77	54·13	73·78	84·26	63·26	37·51	75·81	68·55	63·26
Fine Silt ...	3 02	1·19	24.55	17 36	4 86	27·30	33 44	14·26	12·18	27·30
Clay ..	5·19	0·62	2 31	0·62	4·76	11·52	18·62	1.50	2·54	11·52
Moisture ...	7·24	3·66	3·96	5·70	4·08	6·90	7·47	6·88	4·18	6·90
Retentive power for water ...	65·0	50·0	61·0	—	60·0	—	63·5	—	58·0	—

Chemical Analysis.

Constituent.	Caswell Hill Vere. Banana Land.	S. Catherine Irrigated. Banana Land.	Vere Estate 1 'general Soil.'	Vere Estate 2 'clay soil.'	Vere Estate 3 'gall. A'	Vere Estate 4 'gall. B.'
Insoluble Matter	64·85	71 06	64·74	61·73	61·79	64·75
Soluble in Hydrochloric Acid	35·15	28·94	35·26	38·27	38·21	35·25
Potash	0 111	0·445	0·498	0·492	0 502	0·490
Lime	0·628	1·573	0·444	0·459	0.665	0·684
Phosphoric Acid	0.058	0·194	0·163	0·176	0·215	0·142
Carbonic Acid as Carbonate of Lime	0·116	0 483	0·065	0·119	Nil	Nil
Combined water and organic Matter	10·32	7·09	10·37	12·40	11·11	10 09
Humus—Soluble in Ammonia	2·11	1·60	1·093	1·324	1·19	1·26
Nitrogen	0·125	0·152	0·102	0·117	0 096	0·124
Moisture	7·81	3·80	4·12	4·25	5 05	4·36
Available Potash	0·0011	0 0110	0·0120	0·0114	0·0123	0·0110
Available Phosphoric Acid	0·0051	0.0720	0 0552	0 0643	0·0723	0·0435

The analytical data are mainly the work of Mr. H. S. Hammond, F.C.S.

JOB'S TEARS SEEDS.

By H. H. COUSINS, M.A., F.C.S.

Island Chemist.

The seeds of *Coix* Lacrima-Jobi, popularly known as Job's Tears are used as food for poultry and two samples have been submitted to the Laboratory for analysis.

The outer husk is very hard and the seeds must be crushed before being fed to the fowls. The digestible portion is mainly starch and this food can not be recommended for laying fowls. It should, however, prove a useful material for feeding to poultry in process of fattening for the table.

The analytical data as determined by Mr. H. S. Hammond, F.C.S., are as follows :—

Constituents.	Mr. Barclay's sample.	Mr. Miller's sample.
Moisture	9·87	7·33
Fats	0·62	0·52
Nitrogenous matter*	7·44	6·56
Indigestible Fibre	21·96	19·21
Carbohydrates	43·52	51·02
Ash	16·59	15·36
Total	100·00	100·00
* Nitrogen	1·19	1·05

GRAM.

It will probably be found advisable to grow some crop in rotation to cotton, and perhaps the one best suited to the purpose is a kind of pea or bean known as "gram."*

It is extensively grown in India as a fodder for horses, and for this purpose it is no doubt more valuable than corn, inasmuch as there is a larger proportion of muscle-forming food.

An experiment has been made in growing it at Hope Gardens. On the 24th March last a small plot was planted, measuring about 128 sq. yards, with gram. The seeds were planted, at distances of 9 inches in rows which were 2 feet apart. They germinated in six days and the plants grew rapidly, without irrigation, producinga fine crop of pods. Beyond weeding and stirring the surface of the soil once, no cultivation appeared to be necessary. The

*Cicer arietinum, Linn.

plants were gathered on the 9th June, that is 77 days from date of planting, and the yield was 4 qts. of seeds which were placed in the tobacco curing house to dry, but were unfortunately destroyed by rats the first night.

Dr. George Watt in " Economic Products of India" says :—

Chemically, a horse diet which consists exclusively of cereals cannot possibly be so good for the animal nor so likely to produce muscular strength as a diet with a liberal admixture of some kind of peas. Husked gram contains of albuminoids 21·7 per cent., and of starch 59·0 per cent. Indian corn contains only 9·5 per cent to 70.7 per cent of starch. When it is recollected that the albuminoids are the muscle forming constituents of diet, it becomes apparent that a diet which contains oats and gram, or Indian corn and gram would be more nutritious and strength-giving than the modern English food for horses, of oats and Indian corn. To obtain the indispensably necessary amount of albuminoids from an English diet, the animal has to eat a greatly excessive and injurious amount of starch.

Prof. Church gives an analysis as follows :—

Composition of the Chick-Pea.

In 100 Parts.

	Husked.	With Husk.	In 1lb. Husked.	
			Ozs.	Grs.
Water ...	11 5	11 2	1	367
Albuminoids ...	21·7	19 5	3	207
Starch ...	59·0	53·8	9	192
Oil ...	4 2	4·6	0	294
Fibre ...	1·0	7·8	0	70
Ash ...	2·6*	3·1†	0	182

" The nutrientratio in the unhusked peas is 1 : 3·3 ; the nutrient value is 84.

" The unhusked peas are therefore more nutritious than the husked, and it may be concluded that the process of steeping them in water before being mixed with the oats or other cereal both softens the pea and removes entirely the dust and mud associated with the pulse.

" In medicine the seeds are considered antibilious. The chief interest medicinally is, however, in the acid liquid obtained by collecting the dew-drops from the leaves. The fact that the drops of dew are thus chemically changed through contact with a living plant is a point of great botanical interest The liquid is found chemically to contain oxalic, acetic, and malic acids. This vinegar is mentionod by the old Sanskrit writers as a useful astringent, which might with advantage be given in dyspepsia, indigestion and costiveness.

" A piece of clean cloth is tied to the end of a stick and the pulse crop is brushed with this in the early morning, so as to absorb the dew. This is then wrung out and preserved.

" It is useful in diarrhœa and dysentery, and is given as a drink with water in sunstroke. The boiled leaves are applied as a poultice to sprains and dislocated limbs. The fresh juice of the leaves mixed with crude carbonate of potash is administered with success in dyspepsia. The acid liquid is employed as a refrigerant in fever.

" The seeds are greatly used as an article of food by the natives, being ground into meal, and either eaten in puddings or made into cakes. They are also toasted or parched, and in this state are commonly carried for food on long journeys. Rolled in sugar-candy, these toasted peas form a rough sort of comfits and gram-flour made up with sesamum oil and sugar-candy is an Indian sweetmeat.

* 1·1 of Phosphoric Acid.
† 0·8 of Phosphoric Acid.

THE BROWN ANT IN ORANGE ORCHARDS.

By O. W. BARRETT, *Entomologist and Botanist, Porto Rico Agricultural Experimental Station.*

Excepting the scale insects the most serious pest at present affecting young orange trees in Porto Rico is the Brown, or Stinging Ant, *Solenopsis geminata,* Fab. It has already caused very serious damage to citrus stock in many localities and unless immediate measures are taken to check its increase, greater loss will follow.

Ordinarily this species of ant lives in rather small colonies of about 5,000 to 15,000 individuals in nests in the soil and subsists on small seeds, dead insects, and the honey-wax secreted by scale parasites. Upon becoming established in an orange orchard, however, this ant forms at the foot of the tree a nest composed of several galleries, or passages, extending to a depth of about 6 inches and having 1 to 3 openings at the surface of the soil close to the trunk. A nest may contain a dozen or more queens if it is well established, and these qeeens deposit the numerious eggs near the ends of the burrows, where the young ants may be found in all stages of growth. From this nest the working individuals, accompanied by the "soldiers," or large-jawed ants of the colony, pass up the tree trunk to feed upon the wax-like substance secreted by the scales and to obtain the gummy excretion from the wounds which they make in the bark of the twigs and branches for this purpose. They also frequently damage the flowers, young fruit, and terminal buds : even small twigs are sometimes completely severed by their gnawing through the tender wood in their greediness to obtain a rapid flow of the gum.

A colony of these ants may live at the base of a tree for several weeks, merely feeding upon the wax of the scales and doing no injury to the bark, but when they have once acquired a taste for the gum they seem to prefer it to the wax. The worst feature of this acquired habit is the formation of open sores at the base of the trunk ; the continual biting of the margins by the ants gradually enlarges the wounds and, if not attended to, these sores spread and commingle till the tree is girdled.

In view of the fact that grave financial loss has already resulted in many of the citrus orchards of this Island through loss of trees from the attacks of this ant and through the injurious effects of various chemical mixtures applied experimentally to the trees in combating the pest, it seems advisable to urge the use of the following safe, cheap, and simple remedies which we have found to be the most practicable of a dozen or more similar mixtures.

GIRLE PAINT.

Unless covered with some substance which keeps out the air and water, the exposed wood in the wounds of the trunk is a menace to the life of the tree, not only through loss of sap by evaporation but by rotting of the wood and poisoning of the sap resulting from water entering the cracks.

This girdle paint, which is a kind of grafting wax, is prepared as follows:—4 parts of common yellow resin and 3 parts (by weight) of linseed oil (preferably "raw") are melted together over a slow fire and boiled for about ten minutes. After removal from the fire, but while still hot, this liquid is beaten up with a small per cent of cold tobacco tea : about one-half pint of the tea to each 3 pints of the resin-oil mixture is a good proportion but this may vary with the kind of oil used, length of time of boiling, etc. The tobacco tea should be added little by little while the wax is being rapidly stirred. The addition of the tobacco tea will thicken the brown liquid to a yellowish, semi-solid wax which should retain its intense thickness for 2 to 4 days when applied to the tree.

This wax possesses the following properties :—impermeability to water and air, thus preventing drying out and rotting of wood or bark over which it is spread; stickiness, which prevents the ants passing over it until it gradually hardens on the surface ; and toughness, which prevents the ants gnawing through it, thus allowing the wounds to heal over with new bark. A small paint brush is well adapted for applying the wax, which should be of the consistency of thick cream at ordinary temperatures. It should not be applied while the bark is wet. In bright sunshine this wax will run slightly after being applied.

For stopping the passage of ants up the tree a ring of the girdle paint about 2 inches wide is made around the trunk just above the surface of the ground ; by putting à second ring about 6 inches above the first the ants are usually frustrated in their attempt to regain passage to the branches by carrying up particles of earth to form a quasi-bridge over the lower ring. All branches and weeds affording direct passage between the ground and tree top must be removed at the time of applying the rings. Unless used in conjunction with the ant killer several applications may be necessary at intervals of 2 to 4 days.

This wax should be used also for covering the wound when the "spur" is removed and for the raw surfaces left by pruning.

Either tobacco stems or dust may be steeped to prepare the tea. Water may be substituted if the tobacco is not readily procurable. The cost of this preparation should be from 10 to 15 cents per quart if the ingredients are bought in small quantities. Only the purest linseed oil (free from cotton seed oil) should be used. A small amount of tallow, about one-fourth the amount of oil used, may be added to the resin and oil and melted up therewith ; this forms a wax of very durable tenacity but it is more difficult to combine with the tobacco tea in thickening it. In all cases the tea must be stirred in until no drops of the water can be seen upon its standing several hours. If this paint hardens after standing or does not spread easily with the brush, it may be re-melted with a very small quantity of oil added.

ANT KILLER.

Since the Girdle Paint can only prevent the ants from injuring the tree to which it is applied, the following preparation is recommended for exterminating them in the grove:

Resin, 2 parts; sal soda, 1 part; tobacco tea, 1 part. Boil all together, stirring slowly over a slow fire till all the resin is dissolved. After simmering about 15 minutes, remove from the fire and add little by little 10 to 15 parts of tobacco tea, stirring rapidly for five minutes or more; this should produce a very frothy soap which contains only just enough alkali to hold the resin in solution. Apply with a large syringe or coarse-holed spray pump directly to the open holes or galleries of ants' nests.

If properly mixed a few spoonfulls of this liquid applied on top of an ant nest will sink into the passages and flow along the tunnels, killing the ants and filling up the galleries, without injuring the tree roots. If too thin it will soak into the soil and be wasted; if too thick it will not reach the centre of the nest to kill the eggs and queens. The effect of this mixture upon the ants is both chemical and mechanical; the caustic action of the soda destroys the eggs and the soft parts of the adults, while the resin forms a sticky, air-tight coating over all surfaces with which it comes into contact.

This ant killer is of some use in combating the May beetle or "Caculo;" in orange orchards. When applied to the openings of their vertical burrows it runs down and kills or drives out these insects and their grubs which may be at the bottom of the hole. But this should not be used in large quantities around the roots of young trees, since the caustic action of the sal soda might injure the small roots.

The ordinary fine-spray pump is not adapted to this work, since it becomes clogged easily and does not leave the mixture in a frothy state. The common garden brass cylinder syringe having a few holes in the tip serves the purpose well.

The cost of this preparation, ready for applying should be a little less than 1 cent per quart.

CULTIVATION OF TOBACCO UNDER CLOTH.

Remarkable and immensely profitable results are being obtained in a number of cigar-leaf producing countries of the world through the growing of cigar wrapper leaf under a special cotton fabric known in Cuba, as cheese cloth, and in the United States as tobacco shade cloth.

In Cuba in the season commencing in the fall of 1903, about one thousand acres of tobacco was grown under cloth; in Porto Rico about 250 acres; and the same year in Florida there was grown under shade about 2,500 acres, with about 700 more in other parts of the United States which produce cigar-leaf.

The plan is also being tried in the East Indies, and promises to be adopted in every district suitable for the cultivation of tobacco for making cigars. The acreage under cloth in Cuba in the autumn of 1904 will be in the neighbourhood of 2,000 acres, of which one-third will be grown by the American Tobacco Company, through its allied companies.

The effect of growing tobacco under cloth in Cuba is as follows: The yield of the tobacco is greatly increased as compared with out-door tobacco; the plants being protected from the elements and insects, the leaves are perfect, being neither torn by the wind or rain nor eaten by insects; the plants start to grow more rapidly and are thriftier in every respect; the effect of the partial shade afforded by the cloth is to make the leaves thinner, of finer texture, and more desirable in every respect for the wrapping of the finest grades of cigars.

The cloth not only covers the top of the framework over the field but comes down to the sides, in the form of walls, so that the entire field is enclosed and covered by the cloth.

Erection of the frames; as done in Cuba:

Posts about four inches in diameter and twelve feet long are set three feet in the ground (so that nine feet projects above the surface of the earth) and 16½ feet, English measure, apart in each direction. There is therefore a post every 16½ feet each way, over the entire field. From post to post in each direction is stretched a No. 9 galvanised steel fence wire, being stapled to the top of each post where they cross. Additional smaller wires of No. 12 or No. 14 size, are then stretched parallel, about three to each space of 16½ feet, coming down at the sides of the tent and being fastened to stakes, as, it should be added, are the No. 9 wires previously mentioned.

The cloth is furnished in the width of 200 inches, English, for the top, and in pieces from 50 to 100 or more yards long. The cloth is stretched between each space of 16½ feet in a direction at right angles to the small wires, and it is usual to weave the cloth above and below these small wires, and the parallel No. 9 wire, alternately. The two edges of the cloth are then wrapped about the No. 9 wire and sewed with cords, the stitches being made about three inches apart.

Another method is to have stringers or pieces of lumber 2 x 4 inches, nailed from post to post in one direction, and supporting parallel smaller wires at right angles to these stringers. The cloth is then stretched over these parallel wires, and nailed with staples to each stringer. This frame costs more than the post and wire frame described in the preceding paragraphs.

In most tents, the cloth at the sides is brought to the ground at an angle, the baseboard to which the cloth is stapled being about six feet out from the last line of posts. This presents a slanting side to the wind, and deflects the wind above the tent, so that it does not receive it with the same force as a tent with straight

sides. For this reason, cloth for the sides is furnished in the width of 144 inches, which is right for the angle formed by the slant from the top of a post nine feet above the ground to a baseboard set six feet out from the line of posts.

The lower edge of the wall cloth is fastened with staples to the top of the baseboard, and it is usual to roll this edge of the cloth around a small wire before stapling; then put in the staples every three or four inches, embracing the rolled cloth with the wire within.

Millions of yards of the tobacco shade cloth are supplied annually to the tobacco growers of Cuba and other cigar-leaf districts, and the cloth gives the utmost satisfaction because it is designed and woven for this particular purpose, and comprises the experience of a number of years in this special fabric. The cloth is woven of high grade cotton, the yarns being hard twisted for the purpose of resisting mildew, and the cloth is used for one, two or three seasons in succession, according to the climatic conditions; but in some damp climates, with especially rainy seasons, the cloth may last but one season, or at the most, two. Cloth made of jute has been tried for this purpose, but proves to be an entire failure, as the jute rots rapidly when exposed to the weather, and the shade growers are using exclusively the cotton cloth, as made by Amory, Browne & Co.

To order cloth for a field, get for the top of the tent as many square yards as there is in the surface of the field; and for the sides of the tent, made slanting, get as many running yards of cloth 144 inches wide, as there are yards around the edge of the field. About five per cent additional cloth should be ordered, to allow for waste in putting on, for covering the doors and other purposes. Large tents are the most economical as to cloth, because there is much less side or wall cloth in proportion to the area of the field.

The tobacco plants are set out in the usual manner, except that they are usually set a little closer together in the row than the outdoor tobacco. In the United States about 13,000 plants are set to the acre, and in some parts of Cuba as many as 22,000 plants to the acre. The cultivation proceeds in the usual manner. It will be found that the plants grow to a much greater height under the cloth than outside, on the same land and under the same weather conditions, and that many more leaves are obtained on each plant. The tent is put up in advance and the cloth is put on just previous to the setting out of this plants.

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House, on Tuesday July 12th, 1904, at 11.15 a.m.: present, His Excellency, Sydney Olivier, Esq., Chairman, the Director of Public Gardens, the Archbishop of the West Indies, the Island Chemist, the Superintending Inspector of Schools, Mr. J. W. Middleton and the Secretary, John Barclay.

With regard to the plough steers at Hope,—on the recommendation of Mr. Cork, who had inspected them and pronounced them to be past their best, it was ordered that they should be fattened and sold and a pair of fresh steers broken to Cuban yoke bought in their place.

An estimate for the providing of proper appliances for curing Sumatra tobacco to be grown at Hope again was submitted. The Director of Public Gardens was instructed to get all the information he could as to the methods used in Florida, as the conditions there are somewhat similar to those of Jamaica.

A letter from the Colonial Secretary was submitted informing the Board that the Hon. Thomas Capper, Superintending Inspector of Schools, and Mr. J. W. Middleton had been appointed members of the Board.

The report of the Sub-Committee appointed to enquire into the cotton industry was submitted. It recommended that the Board should do all in its power to bring strongly to the notice of the Government the advisability of pushing this industry with all the resources at its disposal, and especially to foster cotton growing in the plains of St. Elizabeth where little, that can be exported, is grown at present. The Committee also recommended that the Board should get into closer connection at once with the British Cotton Growing Association and impress on them the capabilities of Jamaica for growing cotton, that the people were awakening to the importance of the industry, the results of experiments so far made and the price of Jamaican cotton already marketed. The Chairman said that it might be a good plan to recommend that a small patch of cotton be planted in school gardens, so that children might see its growth, know when it was fit and learn how to pick it. As regards the grant given by the Board of Agriculture, the Superintending Inspector of Schools reported that school gardens were being started in about eleven schools under the Board's scheme. The Chemist said he had taken the Board's scheme to mean that there should be four model school gardens in four different parishes, as centres which all other school teachers and scholars could see, and visit as models. The Superintending Inspector was asked to map out six or seven schools in good centres to be cared for by the school masters, but to be under the supervision of Agricultural Instructors, as far as possible.

Papers on the cost of cassava growing and the manufacture of cassava starch were submitted and directed to be circulated.

Papers on analyses of soils from the Chemist with remarks from the members of the Board were submitted and the Chemist was asked to write short and simple articles on manures for the Agricultural Journal, more elaborate articles having already been published in the "Bulletin."

A lettter from the President of the Central Cornwall Agricultural Society was submitted, giving an appreciation of Mr. Cradwick's work in that district and expressing the regret of the local society that it was proposed to transfer him at the end of the year.

A report by Mr. Cradwick on his experiments on coco-nut trees was submitted and directed to be kept in hand until further experiments could be made before publication of particulars.

The following reports by the Chemist were submitted :—

(*a*) *Laboratory Buildings.*—Reporting that the Public Works Department had made a start on the extension.

(*b*) *Water Supply for Canes at Hope*—Reporting that pipes from the special main of the reservoir for the canes had been brought up and that the work was progressing satisfactorily.

(*c*) *Land for Seedling Canes*—Showing that there were four acres under cultivation, two under old canes and one under new seedlings of 1904, but that two acres more would be wanted in October, which proposed should be planted on some spare land at the Prison Farm, Spanish Town. The Chairman said he would arrange to visit the Prison Farm on an early date with Mr. Cousins and chose the land.

(*d*) *Use of Native Sugars for Preserves*— Showing that our sugars were of unusual purity and high quality, that he had found Sulphur Dioxide and Calcium Bi-Sulphide harmless preservatives,— not affecting the flavour of the preserves,—effective in preserving fruits in syrup and jams, made of native sugars and that he was importing these preservatives for further experiments on commercial lines.

(*e*) *Thymol*—Reporting that such had been the demand that he had to cable for a further supply, to be sold at 7/3 per lb. This was approved.

(*f*) *Analyses of Banana Soils* from Porto Rico—Reporting that he had been requested by Mr. Collins of the Division of Tropical Agriculture, U.S.A., to analyze a series of soils from Porto Rico representing areas that might prove suitable for banana cultivation. The Board decided that the Chemist should reply that while willing to put all the results of his investigations of Jamaican soils before Mr. Collins, the amount of work before his Department would prevent his undertaking the analyses of soil for the Porto Rican Government.

(*g*) *Work of the Mico Students*—Reporting that the work of Mr. T. J. Harris with the Mico Students had been highly appreciated both by the men and the authorities of that institution.

The Chemist also submitted a Minute stating that he had conferred with Mr. McFarlane, Mr. Cunningham and Mr. Teversham and they agreed with his opinion that steps could now be taken to place the whole teaching of the Mico Students on a more systematic basis, and he was requested to draw up a scheme of agricultural teaching for the consideration of the Board.

Reports were submitted from the Director of Public Gardens as follows :—

(a) On Mr. Cradwick's work.

(b) " Mr. W. J. Thompson's work.

(c) " Hope Experiment Station.

(d) " *Criollo Cocoa & Rubber*—Reporting on a visit to Hanover together with Mr. Collins of the Division of Tropical Agriculture, U.S.A., and the inspection of the Criollo cocoa trees commonly grown there ; also of some Castilloa Rubber trees growing there, with a summary of Mr. Collin's views on Rubber-growing from investigations made in Central America.

(e) Offers for cured tobacco grown at Hope.

A GOOD SHADE TREE FOR PROTECTING STOCK.

By W. J. THOMPSON,

Superintendent of Kingston Public Garden, and Travelling Instructor.

One of the best shade trees for cattle and sheep would be Ficus indica, one of the Banyan trees of India. This tree is very hardy, will stand drought and wind, and gives shade all the year through. It does not propagate itself by seeds, so will not cause expense in cutting out young trees. If planted properly and fenced from stock in its young days, it will grow rapidly and soon form a good tree and cover a few chains of land. In all my travels I have not seen a shade tree to equal it.

A good specimen tree, the finest in the Island, can be seen on the lawn at the northeast corner of the Parade Garden. This tree covers ½ an acre of land. If it will thrive in a dry, windy place like the Parade Garden without any artificial watering this speaks for itself as to the tree being hardy. All pen keepers who own stock should try this tree to keep their animals cool.

THE BREAD FRUIT. III.*

By Henry E. Baum.

(*Continued from the Bulletin for August.*)

The breadfruit tree, celebrated chiefly on account of the bread-like appearance of the pulp of the seedless sort, is also not to be dispised as a yielder of useful articles to the natives of the climes in which it flourishes. Aside from the edible quality of the fruit there are many uses to which various portions and products of the tree itself are put. The possibilities inherent in the milky viscid juice have already been discussed in the opening paper of this series. Bird-lime, paint medium, caulking for canoes, and sizing for wicker pots are some of the uses to which this milk is put. Rubber, however, from *Artocarpus* is pratically settled as being at the best a negative proposition, although many interesting experiments with the latex of this plant are still to be performed before final conclusions can be formulated.

IMPORTANCE TO NATIVES.

Although not so widely used either as a food or useful plant as in primitive times, nevertheless the breadfruit is still one of the most important plants to the Polynesian Islander. Rutland,† writing on the history of the Pacific, quotes from Moresby to the effect that the coconut and breadfruit are the only two large trees capable of growing on the small purely coral islands, hence their importance in Polynesia where so many of these islands exist.

Another indication of its value in the eyes of the natives is the existence in Tahiti of a legend which in abstract is as follows:—"A father had an only son, whom he loved tenderly and who was unable to eat the red dirt that constituted the diet of the people. After praying earnestly that his dead body might become food for his son, his request was granted and from his buried dismembered body arose a large and handsome tree, clothed with broad shining leaves, and loaded with breadfruit."‡

Ellis also records that the appearance of the natives is perceptibly improved in a few weeks after the fruit comes into season while Captain David Porter tells of natives in the Marquesas who who could not conceive of a land without breadfruit.

SEEDS.

The seeded variety of the breadfruit is common in the West Indies, while the existence of the sterile sort in some islands is considered doubtful on account of its scarcity. The tree generally receives the name of "castaña," the Spanish word for chestnut in these islands, on account of the resemblance of the seeds to that nut. These often appear in a germinating condition in the Porto

* Reprinted from the *The Plant World*, VI, 273, Dec.

† Rutland , Trans. New Zealand Instit., 29.9.

‡ Full legend is given in Vol. 1 of Ellis's "Polynesian Researches."

Rican markets and are ready to be eaten after a few minutes' boiling. The seeded variety is called "dug-dug" or "dog-dog" in Guam, while the seeds, rich in oil, are known as "nangka."

WOOD.

According to Grosourdy (2 : 406) the trees furnishes a wood yellowish gray in color; rather light and soft, but strong, resistant, and elastic, and with a specific gravity of 0·495. It resists the attacks of the white ant and only needs to be kept dry to be fairly durable. The framework of Samoan houses is made of the curved limbs of breadfruit, beautifully rounded, and joined together and wrapped at the edges with coconut sennit. Other species of this genus yield valuable woods, among which may be mentioned the "Anjeli" wood (*A. hirsuta*) and *A. chaplasha* of India. The wood of most of the genus is light yellow when cut, but darkens with exposure and age to a mahogany color. The wood of the Jak (*A. integrifolia*) not only takes on a fine mahogany color, but also yields a yellow dye which serves as a mordant for other vegetable dyes.

CLOTH.

In the primitive days in the Pacific, before the advent of the trader with his beads and calico, the natives were dependent upon natural products for their scanty wearing material. The cloth prepared from the inner bark of the paper mulberry (*Broussonetia papyrifera*) was by far the most valuable, although the product of the best of the breadfruit was not despised as a cloth producer. Mr. W. E. Safford of the Department of Agriculture says that in Samoa, owing to the abundance of the paper mulberry, the natives do not use the breadfruit in this connection, while in Guam the practice, common in olden times, has of late been discontinued. The paper mulberry does not grow in Guam; the bark is not extracted by the Fijians. In Captain Cooks' First Voyage (Vol. 2, pp. 211-213, Hawkesworth Ed.) there is an extended account of the preparation of the cloth from the inner bark of the breadfruit, unfortunately too long for quotation at this time.

MISCELLANEOUS USES.

In the *Journal of the Jamaica Agricultural Society* for November, 1900 (pp. 668, 669), Mr. W. Kirkland suggests the preparing of banana and breadfruit flour for fodder from small and imperfect fruits. The fruits require but a day's drying on the rocks in the sun after being sliced, and are then ready to be ground, sifted, and fed to the stock. According to Mr. Kirkland the flour was eaten with relish by horses and he has often seen stock eating bananas and breadfruits as they lay rotting on the ground. Two bunches of bananas made 10½ quarts of flour according to his account, but no mention is made of the size of the bunches. Outside of the use of this flour as fodder the banana flour makes a good esculent, which can be cooked in various ways, and was preferred by the author to cornmeal, yams, or coconuts.

According to Mr. W. E. Safford the breadfruit grows so plentifully on the island of Guam "that it might prove profitable to utilize it there for the manufacture of starch, or 'arrowroot.' as has been successfully done in the French colonies of Martinique and Réunion, and in Brazil." Horses and cattle are fond of the leaves and they are often used as fodder. In some of the Pacific islands the natives say "that no one eats the breadfruit raw, except hogs," and these animals grow very fat in the breadfruit season.

During the Cuban insurrection many refugees sought sanctuary in New York, and it was then that an attempt was made to transport fruit from Jamaica to the metropolis in accordance with a desire for the fruit among the patriots. Mr. J. W. Gruber, of Montego Bay, Jamaica, claimed that fruits with their outer surfaces charred will keep for months and be readily transportable to New York, but before the experiment could be tried the war was over and a seemingly favorable market ruined. No other similar attempt has been made, so far as records are known to us.

According to Engler in the "Naturlichen Pflanzenfamilien," the roots of the breadfruit possess astringent qualities, a decoction being taken internally in cases of diarrhœa and dysentery, while it is also applied externally to cutaneous disorders.

In the tropical Pacific, where it is peculiarly at home, the breadfruit serves as a food-staple along with the banana, yam, taro, and sweet potato, and is also responsible for the development of many interesting culinary customs. A research into the culinary methods employed in the Pacific islands would be an interesting ethnobotanical study; but we can only linger over a few of the leading features and leave origins and migrations alone.

A method spread throughout the Pacific is that of fermenting the fruit in underground pits, in which condition it keeps from year to year. Captain Cook describes the process from Tahiti as follows:

"The fruit is gathered just before it is perfectly ripe, and being laid in heaps, is closely covered with leaves; in this state it undergoes a fermentation, and becomes disagreeably sweet; the core is then taken out entire, which is done by gently pulling the stalk, and the rest of the fruit is thrown into a hole which is dug for the purpose, generally in the houses, and neatly lined in the bottom and sides with grass; the whole is then covered with leaves, and heavy stones laid upon them; in this state it undergoes a second fermentation, and becomes sour, after which it will suffer no change for many months; it is taken out of the holes as it is wanted for use, and being made into balls, it is wrapped up in leaves and baked; after it is dressed it will keep five or six weeks. It is eaten both cold and hot, and the natives seldom make a meal without it, though to us the taste was as disagreeable as that of a pickled olive generally is the first time it is eaten.*

* "Cook's First Voyage," Vol. 2, p. 198 (Hawkesworth Ed.)

The Samoans called the cakes which they baked from this mixture *masi,* a name which they also apply to ship-biscuits and crackers. The Tahitians call it *mahie,* and use it in much the same way, as do also the Fijians, who call it *madrai.* To European nostrils the aroma of this preparation is far from appetizing, a condition of affairs which is reciprocated, however, when Polynesians are confronted with European cheese. The *masi* or cakes are generally reserved for use during times of scarcity of the fresh breadfruit and taro.

"The general and best way of dressing the breadfruit is by baking it in an oven of heated stones. The rind is scraped off, each fruit is cut into three or four pieces, and the core carefully taken out; heated stones are then spread over the bottom of the cavity forming the oven, and covered with leaves, upon which the pieces of breadfruit are placed; a layer of green leaves is strewn over the fruit, and the other heated stones are laid on the top; the whole is then covered with earth and leaves several inches in depth. In this state the oven remains half an hour or longer, when the earth and leaves are removed, and the pieces of breadfruit taken out; the outsides are in general nicely browned, and the inner parts present a yellowish or white, cellular, pulpy substance, in appearance slightly resembling the crumb of a small wheaten loaf. Its color, size, and structure are, however, the only resemblance it has to bread. It has but little taste, and that is frequently rather sweet; it is somewhat farinaceous, but not so much so as in several other vegetables, and probably less so than the English potato, to which in flavor it is also inferior. It is slightly astringent, and as a vegetable, it is good, but it is a very indifferent substitute for English bread.*

Dampier tells us also that the natives of Guam use it as bread "gathering it when fully grown, while it is green and hard, and then baking it in an oven, which scorches the rind and makes it black; but they scrape off the outside black crust, and there remains a tender, thin crust, and the inside is soft, tender, and white, resembling the crumb of a loaf." Comm. Anson, whose visit to Guam has already been noticed, further tells us that "the Spaniards slice it, and expose it to the sun, and when brought thereby to a crispature, they reserve it as a biscuit, and say it will bear long keeping when so prepared." According to Mr. W. E. Safford of the U. S. Department of Agriculture the natives of Guam also dry these slices in ovens. † The fruit, according to the same authority, is rather tasteless, unless eaten with condiments such as butter, salt, gravy, etc. The Chamorro population of Guam have abandoned the custom of fermenting the fruit in underground pits, a custom which is retained, however, by the Caroline Islanders, who sought refuge on the island from tidal waves

*Ellis's "Polynesian Researches."

†W. E. Safford "Notes of a Naturalist on the Island of Guam."

in their own group years since, and who have retained many of their primitive customs.

Horne,* writing of the fruit from the Fijis, says that "the quality of some of them is excellent, dry and mealy like a potato; that of others as watery and insipid. They are either baked or boiled, and eaten alone, or with pork or fish. Sometimes they are made into puddings, or buried under ground, and made into *mandrai, i.e.* native bread."

CONCLUSION.

This short sketch of the natural history, history proper, and uses of the breadfruit does not pretend to even approach completeness in any of the three categories mentioned, owing to the absence of literature of a useful character. It only strives to be a foundation, if possible, for future work on the subject which will put the subject matter in a stronger light.

Flowers, fruits, and trees have always figured largely in song and story, and oriental imagery in particular is full of references to natural products, among which the coconut possibly takes first place. In Polynesian folklore, appropriately enough, the breadfruit, as we have seen, plays an important part, and its praise has been sung by poets of many lands. Lord Byron, inspired by the tales of early voyagers, describes it in the following beautiful lines:

> "The breadfruit tree which without the plowshare yields
> The unreaped harvest of unfurrowed fields,
> And bakes its unadulterated loaves
> Without a furnace in unpurchased groves,
> And flings off famine from its fertile breast,
> A priceless market for the gathering guest."

*Horne, "A Year in Fiji," pp. 82, 83. London 1881.

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. OCTOBER, 1904. Part 10.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
HOPE GARDENS.

1904.

JAMAICA.

BULLETIN

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Vol. II. OCTOBER. 1904. Part 10.

BERMUDA ONIONS IN JAMAICA.

In the Bulletin for March, notes were published on the onion, and it was stated that seed was being obtained through Sir D. Morris, from Teneriffe. This seed, both of red and white onions, has arrived, and will be distributed to applicants at the rate of three-pence per ounce or four shillings per pound. Application, accompanied by a remittance, should be addressed to the Director of Public Gardens, Kingston, P.O.

BEETLE PESTS.

LEAF EATING BEETLE.

A correspondent sent specimens of a beetle about three-quarters of an inch long, of a shining black colour, complaining that it was "very destructive to rose trees and several other plants, not allowing any buds, flowers, or young leaves to come out, before they are seized on and eaten off."

Paris green was recommended as a remedy, to be applied as advised in the Bulletin for July.

The specimens were referred to Mr. E. S. Panton, Curator of the Museum, who writes :—" The beetles are a very destructive species of Lamellicornes (Antichira meridionalis). They often descend in countless numbers on different trees and plants at this time of year, sometimes entirely defoliating them. Trees that are usually attacked are the Poinciana and Trumpet. At this moment they are crowding on some Trumpet trees shading my coffee here. I find the larva feeds on the decayed wood of the wild Calabash.

Branch cutting Beetle.

Revd. George Davidson, Arcadia, Chapelton, writes :—

"Accompanying this I send you for inspection a bit of stick of the Beechwood. You will observe one end has apparently been cut by a saw. I have recently found many such pieces some very much thicker but all bearing the same appearance. The cuttings are not confined to any one particular kind of tree. I yesterday saw two much thicker branches of the tamarind tree. I am curious to know what is the insect or reptile responsible for this work. Some of the peasantry attribute it to a large lizard known to them as "Dom Sawyer." Your opinion will be greatly appreciated."

The insect responsible is a beetle* which lays its egg in a branch near the end, and gnaws the wood right round, so that the end dies and falls off. The larva feeds on the dead wood, and only emerges when it transforms into the perfect insect. The remedy is to collect and burn all the dead girdled branches which contain larvæ, and to destroy all the beetles when found on the trees.

THE MANUFACTURE OF STARCH FROM THE POTATO IN GERMANY.

By H. H. Cousins, M.A., F.C.S., Island Chemist.

As sugar cane is to the sugar beet so is the tropical cassava plant to the potato of temperate climates. To establish a cassava starch industry in Jamaica on a sound basis it will be necessary to conduct the cultivation and process of manufacture with as efficient methods as those now obtaining in the rival potato starch industry so as to obtain the full benefit of the superior starch producing powers of the tropical plant.

I have therefore thought that it might be of interest to those who are considering cassava as a possible crop for Jamaica to give some general idea of the potato starch industry as at present carried on in Germany.

THE POTATO AS A SOURCE OF STARCH.

The season of growth greatly affects both the yield of tubers and the starch content. There is also a very great variation in the starch value of different varieties of potato and again between individual tubers of the same variety.

The late Professor Maercker, who played the chief part in establishing the potato industry of Germany on a firm agricultural and technical basis, found individual tubers containing as much as 29 per cent. of starch and in a warm season of favourable growth he frequently recorded the analysis of samples containing 25 to 27 per cent. of starch. Maercker found, however, that while some tubers gave this high amount of starch, others from the same

* Oncideres pustulata.

crop grown under identical conditions failed to show more than 16 per cent. of starch. As a rule the small tubers were found to contain less starch than the larger ones.

The richer the seed potatoes in starch, the higher the average starch content of the resulting crop.

Very great progress and development has been achieved in the production of potatoes suitable for starch production by selection and the raising of seedlings from selected parents.

The starch content of the cultivated potato has been raised quite 40 per cent. over that of the old standard by this means and varieties of high agricultural productivity and vigour have been placed at the disposal of the growers.

The period of growth of the German potato crop is about five months, and as it requires a considerable amount of plant food in this short space of time the soil must be in high condition and a liberal manuring must be maintained to secure good crops.

The value of a potato does not depend upon its content of starch alone: the skin, the "eyes," the fibre and especially the structure of the starch granules are of the highest importance from the point of view of the starch manufacturer.

Compositon of Tubers.

Constituent.	German Potato*			Jamaican Cassava†		
	Max.	Min.	Average.	Max.	Min.	Average.
Moisture ...	79·7	69·6	74·4	66·8	56·2	60·4
Dry matter ...	20·3	30·4	25·6	43·8	33·2	39·6
Starch ...	24·2	14·5	16·6	39·1	24·4	31·6
Sugar ...	1·4	0·1	0·4	1·2	0·3	0·7

A careful study of the potato has shown that it is highly important for the starch factory to secure ripe tubers since these give the largest yield of first quality starch.

The potato crop is liable to various fungoid diseases of the most serious character and the cultivator has to take full precautions against disease.

In certain seasons the losses from disease are very great.

The cassava crop as grown in Jamaica should have a great advantage in its immunity from serious diseases and pests and the unrestricted season of growth and harvest.

* Average of 38 varieties of German Potatos by Morgen.

† Average of 21 varieties of Jamaican Cassava by Cousins.

THE PROCESS OF MANUFACTURE.

The work of a starch factory may be summarised as follows :—

1. Receipt and storage of tubers.
2. Cleaning tubers.
3. Pulping.
4. Washing out the starch.
5. Recovery of starch.
6. Purification of crude starch.
7. Purification of waste starch.
8. Drying starch.
9. Preparation of potato meal from residue.
10. Working up or removing the waste products.

(1.) Potatoes are brought by train or water and are stored in heaps, cellars or sheds.

If the factory is buying potatoes, determinations of the percentage of adherent earth and of starch are made to regulate the price payable.

(2.) The potato washer consist of a series of troughs in which the tubers are slowly stirred under water to remove the adherent dirt.

The tubers are then removed and sprayed with clean water and are then ready for

(3.) *The pulping process.*—The potato is composed of a mass of small cells in which the starch grains are locked up. The object to be attained in the pulping process, therefore, is that of as complete a disintegration of the cellular mass as possible.

This is carried out by means of a revolving drum armed with sharp teeth attached like narrow saws parallel to the axis upon which the drum revolves.

A velocity of 900-1,200 revolutions per minute is imparted to the drum by suitable machinery.

The potatoes falling against this revolving drum are rapidly reduced to a fine-grained, foaming reddish pulp.

It is usual to moisten the tubers with an equal weight of water to facilitate the pulping.

The pulp consists of the juice of the tubers, free starch granules, fibre and cells still unbroken. In small factories the fibre and whole cells are removed by sieves and after drying used as cattle food, in larger concerns this product is separated and ground up in a mill so as to liberate more starch. In no case can all the starch in the tubers be liberated.

(4) *Washing out the Starch.*—The separation of the starch from the juices and the fibre is carried out by a system of sieves.

Flat sieves are usually constructed so that an engine can be used to shake them to and fro or else a mechanical arrangement of moving brushes is employed to work the starch through the meshes.

Sometimes revolving cylinders of wire gauze are used.

The coarser sieves have a mesh of $\frac{1}{75}$ inch, the fine sieves are made of the finest wire gauze or of No. 5 silk gauze.

Careful attention to the sieves is one of the first essentials for ensuring a high class product.

The starch "milk" obtained from the last sieve contains, besides

the juices of the tubers and the starch granules, a certain amount of mud and fine particles of fibre and cell-tissue.

Since the sand, starch and the cell-particles are heavier than water they gradually sink and the remaining impurities can be removed by drawing off the liquid. This process is carried out either by sedimentation direct or by a process of running water.

In the former process, vessels 3 or 4 feet in height are used. After 8 or 10 hours the starch has settled, the water is run off and the starch dug out from the bottom with spades.

In the flooding system, a stream of starch water flows over a level wooden channel 5 feet wide, 18 inches deep and 60 or more feet in length.

By this means the greater portion of the starch separates in a purer state than in the sedimentary process, while the lighter and smaller starch granules pass off with the impurities. The starch from the outflow is subsequently recovered by letting the liquid stand in suitable vessels.

The crude starch is a yellowish, brown or red mass which should be quite hard and firm.

This first product is far from pure and is now passed through the process of

(6) *Purification.*—This is generally carried out by working up the crude starch into a 'milk' of about 18° Beaumé and allowing it to settle. After 6 to 10 hours the starch has settled as a hard, white mass with a superficial stratum of a brown. slimy mass of impure starch.

In most cases some treatment with sulphurous acid or bleaching powder is carried out at this stage to whiten the final product. The impure surface layer is removed for further treatment while the lower deposit is secured as the first product of the factory.

Special processes for purifying the precipitated starch from the waste waters and the slimy starch above described are resorted to and a very considerable proportion of the starch set free is finally secured as "superior" and "seconds."

(8) *Drying the Starch.*—This is generally carried out first by centrifugals and then in special drying rooms.

The Bye-Products.

(*a*) *The pulp.*—This contains 88 to 97 per cent. of water. By pressure the moisture can be reduced to about 25 per cent. and it can then be fed to cattle direct or is dried by artificial heat and sold as a dry cattle food.

(*b*) *The waste water.*—This contains much plant food and can be best used for the irrigation of the lands in the close vicinity of the factory.

The returns from a German starch factory.

The following tables given by Dr. O. Saare* represent the efficiency of starch manufacture in Germany under various conditions.

* Die Fabrikation der Kartoffel Stärke.

I.—100 tons potatoes yield.

Per cent. starch in tubers.	Tons Commercial Starch.*			
	Very good working.	Good working.	Average working.	Bad working.
24	25·2	24·3	22·8	19.8
22	22·8	21·9	20·4	17.4
20	20·4	19·5	18·0	15.0
18	18·0	17·1	15·6	12.6
16	15·6	14·7	13·2	10.2
14	13·2	12·3	10·8	7.8
12	10·8	9·9	8·4	5.4

II.—Tons Tubers to produce 1 Ton Commercial Starch (20 per cent. moisture.)

Per cent. Starch in Tubers.	Very good working.	Good working.	Average.	Bad working.
	Tons.	Tons.	Tons.	Tons.
24	4·0	4·1	4·4	5·0
22	4·4	4·6	4·9	5·7
20	4·9	5·1	5·5	6·6
18	5·5	5·8	6·4	7·9
16	6·4	6·7	7·6	9·8
14	7·6	8·0	9·3	12·8
12	9·3	10·1	11·9	18·5

From these data it would appear that it should be possible to produce a ton of commercial starch from less than 3 tons of the best Jamaican cassava manufactured under the most favourable conditions. *The advantage of cassava in Jamaica over the potato in Germany, apart from the intrinsic superiority of the cassava starch quâ starch, is 2 to 1, ton for ton.*

The higher the percentage of starch the greater the proportion recoverable.

* Containing 20 o/o moisture.

The financial basis of the Potato Starch industry.

Output of Starch in Germany

Year.	Tons Starch Total.	Sold to Great Britain.
1890	51,300	24,958
1891	14,700	6,692
1892	12,900	6,719
1893	30,500	12,425
1894	37,000	15,959
1895	30,400	12,649

Price of Starch in Germany per ton.

1890–1	£11	5	0	*to*	£11	15	0
1891–2	37	0	0		39	0	0
1892–3	9	12	6		9	10	0
1893–4	7	12	0		8	0	0
1894–5	8	10	0		8	15	0
1895–6	7	2	0		7	6	0

The very high price for 1891 was due to the disastrous season and the low return of tubers.

Dr. Saare has carefully estimated the value of potatoes to a factory growing its own crop under varying conditions : with a high-grade of potato containing 18 per cent. of starch and commercial starch selling at £8 15s. 0d., the net value of the tubers to the factory is about 20/ per ton with good manufacture and 18/ per ton with moderate efficiency and a sale for the pulp either wet or dry. It would therefore appear that, apart from the intrinsic superiority of cassava starch, and in direct competition with the cheap German article produced at the very margin of agricultural profit, an efficient starch factory in Jamaica should net a return equal to £2 per ton of tubers delivered at the factory. With good land, economically managed, this should bring *a profit of £8 per acre* on the area under cassava.

Dr. Saare estimates the cost of a starch factory as follows :

12–25 tons Potatoes per diem.

Internal fittings and appliances	£1,000 to £1,750
Buildings ...	600 to 1,000
Total cost	£1,600 to £2,750

40 to 50 tons Potatoes per diem.

Internal fittings and appliances	£3,000 to £4,000
Buildings ...	2,000 to 3,000
Total cost	£5,000 to £7,000

250 tons per diem.

Internal fittings and appliances	£12,500
Buildings ...	10,000
Total cost	£22,500

Allowing for interest, depreciation and all charges, the cost of working a ton of potatoes amounts to 8/; with tubers containing 22 per cent. of starch a ton of starch costs 37/ to produce and with ordinary grades of tubers with 16 per cent. of starch the cost of production rises to 53/6 per ton of starch, although 15/ must be deducted from this as the value of the extra output of pulp reducing the net cost of manufacture of starch from potatoes to 38/6 per ton.

So far as I am able to judge, it appears clear and plain that if we can bring to bear upon the cassava industry in Jamaica a modicum of brains, enterprise and business acumen we should be able entirely to replace the German potato starch at present being placed upon the English market with a far better product produced at half the cost of the German article.

Cassava and cotton should form an admirable rotation: both flourish under the same conditions. There are large areas in Jamaica just too dry for bananas or cocoa and at present not producing a net return of 5/ per acre to their owners that might easily produce starch worth £100,000 to £200,000 per annum in the English market.

CITRONELLA AND LEMON-GRASS*

By J. CH. SAWER, F.L.S., F.C.S.**

From all quarters arrive complaints about the obscurity still existing with regard to the actual identity or correct nomenclature of the grasses both wild and cultivated, which yield on distillation oils of considerable commercial importance, and notwithstanding the efforts of botanists, contradictory assertions have been made in text-books, by authorities of repute, especially with regard to the citronella and lemon-grass of the West Indies. Thus, Tschirch ("Indische Heil and Nutzpflanzen" (Berlin 1892, R. Gaertner), page 124) mentions *Andropogon Schœnanthus* Lin., as the mother plant of lemon-grass oil; the same statement being made in Engler and Prantl's "Naturlichen Pflanzenfamilien" and in the annual report

* Reprinted from the CHEMIST AND DRUGGIST, July 30th, 1904.

** It is with great regret that the death of Mr. J. Ch. Sawer on 23rd August is recorded. He was always most willing to assist enquirers and add to the vast amount of information stored in the works published by him,—"Odorographia, a Natural History of Raw Materials and Drugs used in the Perfume Industry, intended to serve growers, manufacturers, and consumers." Gurney and Jackson, London, 1892. The second volume, published in 1894, is a continuation and includes the aromatics used in flavouring. Editor.

of the Buitenzorg Botanical Gardens. Sadebeck ("Die Culturgewachse der Deutschen Colonien," Jena, 1899, 247) states that *Andropogon Schœnanthus*, Linn., is cultivatedin some parts of East Africa and the "fragrant lemon-grass oil" distilled from it is used for adulterating rose oil. *A. Schœnanthus*, Linn., is a variable plant and is sometimes with difficulty distinguished from *A. Nardus*, Linn., botanically (Henry Trimen, "Handbook of the Flora of Ceylon," 1900, v. 242), except by the deep groove in the centre of the glume of the bisexual spikelets, which, however, is sometimes obscure, or even absent. Its var. *versicolor* (Hackel, Monogr, Androp." [1889] 610), however, differs (in Ceylon) from *A. Nardus* in the longer spikelets, though the spikelets *vary so much in the different parts of the spike* as to require a very long botanical description, and even this (*ibid* 241) does not cover intermediate forms, which include some with very broad cordate and amplexicaul bases of the leaves.

Variations in odour and in physical properties of perfectly genuine grass oils are attributable not only to the *species* yielding them, but also to the fact of some of the plants being sub-species, varieties, and forms, and these states have become more or less permanent by cultivation and by change of climate and soil. Such differences in odour and physical properties have also been observed in oils distilled from plants cut in the autumn and in the early stages of growth—especially so with citronella.

CITRONELLA GRASS.

In Ceylon there are two forms of the plant—the wild and the cultivated; the former is called "Maana grass" of the *patanas*. (The *patanas* are immense tracts of uncultivated land in the interior of the island, up to 5,000 feet above the sea. They are mostly in the Province of Ura, and are covered with grass and scrub. They are partly the result of a destructive method of cultivation formerly permitted, called *chena*, which consists in clearing and burning jungle and raising crops for two or three years on the area cleared.) This plant is the *Andropogon Nardus*, Linn., var. *nilagiricus*, Hackel ("Monographiæ Andropogoneæ"), who states in "Monographiæ Phanerogamarum Prodromi" (ed. A. et C. De Candolle, 1889, vi. 604) it to be indigenous on the Nilgiri Mountains. Its spikelets are larger than in the cultivated form, and the glume of the sessile spikelet is sometimes, but rarely, depressed in the central line, or it presents the appearance of a shallow pit.

The other form of citronella is only known in Ceylon in the cultivated state, and is locally called "Pangiri Maana." The only specimen in the Paradeniya Herbarium is so labelled by Dr. Trimen, and with the words, "Cultivated for citronella oil near Deyandera and Mawendelle, S. Prov." It is a tall, robust plant, with broader leaves than the wild plant "Maana," and has an effuse panicle with zigzag branches, divaricate bracts, smaller spikelets, and no well developed awn. It is the *A. Nardus*, sub-species *genuinus* of Hackel (*loc. cit.* 602), referred to by Hooker fil. ("Flor. Brit. Ind."

vii. 206) as *forma culta.* It is now (April, 1904) identified by Forbes and Hemsley (Journ. Linn. Soc." [Bot.] (xxxvi. 376) as synonymous with the *Cymbopogon Nardus* of Rendle (in "Cat. Afr. Pl." ii. 155), cultivated in some parts of tropical Asia, as at Hong-Kong (Hance), and of which there is a specimen in the British Museum Herbarium. Consequently we may infer that this is the plant intended to be figured in Bentley and Trimen's excellent work, "Medicinal Plants," tab. 297, although the plates in that work (by D. Blair) are not, in the opinion of some botanists, specimens of the best botanical drawing and colouration; and notwithstanding the fact that the Editors of the "Tropical Agriculturist" afterwards, in the issue dated October, 1898—probably relying on the authority of "G. Watt's Dictionary of Economic Products" (published 1889-96), iii. 247—permitted the two sorts of Ceylon citronella grass to be designated "Lana Batu" and "Maha Pangiri," but admitted that only two sorts exist on the island. The words are applied in manner to convey the impression that the "Lana Batu" is the more widely distributed of the two kinds and furnishes the bulk of the commercial oil; that the plant was first found in Matara, in the south of the island; that the "Maha Pangiri," which is only cultivated in the neighbourhood of Baddagama, was introduced from Malacca, and thrives on good soil only; that it is apparently cultivated in thé Straits Settlements and in Java; and that it yields an oil of considerably finer quality than the first-named sort. On this point it seems preferable to accept the authority of the late Dr. Trimen, who was an eminent and *practical* botanist, and who, as Director of the Royal Botanic Gardens at Paradeniya, doubtless understood the Cingalese dialects and vernacular better than did either the entire staff of the "Tropical Agriculturist" or even Sir George Watt, of the India Museum and Calcutta (Reporter on Economic Products to the Government of India) himself. (On matters of *quality of the oils* refer to Schimmel & Co.'s "Reports," October, 1898, 18; October, 1899, 17; April, 1900, 12; and THE CHEMIST AND DRUGGIST, 1898, 646.) The description given by Bentley and Trimen in their work, "Medicinal Plants," is as follows:

A large perennial herb with a long, slightly branched, partly aerial rhizome reaching ½ inch in diameter and strongly ringed with the closely packed scars of the leaf-sheaths, the remains of which persist on the upper portion and giving off numerous tough root-fibres. Stem reaching 6 feet or more high, erect, stout, cylindrical, solid, smooth and shining, partially concealed by the leaf-sheaths scarcely thickened at the nodes, which are approximated below, but widely separated above, flat or channelled on one side on the upper portion. Leaves very large and long, numerous, erect, lower ones sometimes reduced to their sheaths; sheaths thick and strong about 6 inches long, close but not entirely enveloping the stem, quite smooth, striate ligule short, brown, laciniate scarious, blade about 2 feet long, linear, very much attenuated at the apex, tapering below, minutely denticulate with forward points on the edges, smooth on both surfaces, pale, somewhat glaucous green, lighter beneath. Spikelets very small, arranged in couples, one stalked, containing one male flower, the other sessile, with one hermaphrodite and often one barren flower; the couples, to the number of three or four, articulated on alternate sides of a short, flattened, jointed rachis, clothed along the edges with long white silky hairs tufted beneath the spikelets, forming a short, acute spike about ½ to ¾ inch long; the spikes arranged in pairs on a common slender stalk,

at the bent nasal node of which is a large, erect, acute, leafy, striate orange-red, shining bract, scarious at the edges, which encloses the pairs of spikes before expansion; the pairs of spikes very numerous placed on the somewhat zigzag, elongated, smooth, slender, erect, flattened branches of elongated panicles which come off in clusters from the axils of the upper leaves, the whole forming a very large, tufted, elongated, somewhat drooping inflorescence often 2 feet or more in length; glumes nearly equal, acuminate, membranous, smooth, purplish, boat-shaped, the lower one of the sessile spikelet flattened on the back against the rachis and without a midrib, those of the stalked spikelets with several parallel veins; pales of the lower spikelet two, or with a third representing a barren flower, very unequal, the lower very small, deeply bifid with two long cusps, from between which comes off a long, slender, slightly kneed, purple awn, about twice the length of the glumes and projecting considerably beyond the spikelet, the upper much larger, acute, but without an awn, very delicate and membranous, without veins; in the flower of the upper spikelet there is but a single membranous non-awned pale. Lodicules two, oblong, truncate, longer than the ovary; stamens three, anthers purple; stigmas two, spreading, protruded from the flower, plumose, bright red-purple. Fruit not united with the pales. Plants have been grown at Kew for many years. The best characters for distinguishing *A. Nardus* from allied species are to be found in its rufous colour, short spikes, and narrow leaves.

The forms of *A. Nardus* met with in the Straits Settlements and Java require verification from fresh material, which the writer will in all probability obtain from reliable sources. The present edition of the "Index Kewensis" gives *A. Nardus*, Linn. ("Sp. Pl.," Ed. 1, 1046), as *Maana* (Ceylon), "Citronella-grass, lemon-grass. Syn. *A. flexuosus,* Nees; *A. coloratus,* Ness; *A. martini,* Thwaites (not of others), *A. Iwarancusa,* Roxb. (in part)? Not previously figured.

Some of the citronella oil produced in the Straits Settlements is of exceedingly fine quality; a specimen from the Selangor Plantations Syndicate (Limited) having been found to contain about 90 per cent. of alcoholic constituents, and being readily soluble in 1½ volume or more of 80 per cent. alcohol. The area under citronella cultivation at Singapore and in the Straits Settlements in 1898 was 954 acres ("Singapore and Straits Directory"), but this is quite insignificant, as regards extent, in comparison with the Ceylon plantations, which, according to the statements of competent dealers in the oil, amounted in 1899 to about 40,000 to 50,000 acres, or 15,000 acres more than in 1896. These plantations are exclusively in the Southern Province, namely between the rivers Gin Ganga in the north-west and Wallawi Ganga in the east; but owing to a decline in the price of the oil in 1899 many large plantations in the Akuressa and Baddagama districts were discontinged. The following are some of the large estates under this cultivation in Ceylon:

Citronella Estate, near Akuressa
Wilpita Estate, near Akuressa
Karyaldeniya " " "
Kananka " " "
Wallahandora " " Galle
Rose Wood " " "
Karayalemyawatte Estate, near Kataluwa
Katherine Valley Estate, near Kataluwa
Ratmahere Estate, near Dodanduwa
Galduwewadda Estate, near Weragoda
Charley Mount Estate, near Weligama
Rose Neath Estate, near Weligama
Nidenwella Estate, near Weligama
Danapatiya Estate, near Weligama
Mellagalpathe Estate, near Weligama
Fred's Ruhe, near Hikkaduwa
Miriswatta Estate, near Tangalla
Panapyittygalla Estate, near Balapitiya
Udabatalahena Estate, near Parawahera
Borakanda Estate, near Ambalagoda

The importance and progress of the business may be estimated by the following figures : The number of stills in use for citronella in 1886 was 290. In 1896 the number had increased to 476, and in 1898 to 600. The progress consists not only in the increase in the number of stills, but also in their improved construction and their larger size.

The exports from Ceylon during the last twenty-three years were as follows :

	Lbs.		Lbs.
1881	121,906	1893	668,530
1882	183,753	1894	938,471
1883	244,755	1895	1,182,255
1884	312,333	1896	1,132,867
1885	410,633	1897	1,182,867
1886	421,612	1898	1,365,917
1887	551,780	1899	1,478,756
1888	659,967	1900	1,409,058
1889	641,465	1901	1,430,168
1890	909,942	1902	1,294,750
1891	7[illegible]3,974	1903	1,062,594
1892	844,502		

The falling-off in the figures in recent years is attributed to the fact that several large plantations in the Akuressa and Baddagama districts have been discontinued owing to a decline in the price of the oil (brought about by excessive competition with grossly adulterated oils), and the fine quality and purity of the Java product (specially distilled for Messrs. Schimmel & Co., of Miltitz), which has attracted many large buyers.

In the year 1902 the produce (1,204,750 lbs.) was consigned to the following countries :

	Lbs.		Lbs.
England	556,096	India	5,400
America	538,970	France	2,376
Germany	146,518	China	17,115
Australia	26,408	Singapore	1,867

These figures do not, however, exactly indicate the real consumption of the countries named, as a considerable part of the oil destined for Germany and France arrives in England merely in transit. It is very probable that Germany takes one-sixth of the entire production, and the consumption in France is very large.

The citronella-grass, which, in India, is so common in the plains and on the lower hills of the North-West Provinces and Punjab, and also abundant about Travancore, has not yet been botanically identified with certainty, but specimens may shortly be obtained by the writer, and will then be submitted to expert judges of the particular genus.

In the vernacular, the grass is known under the following names, which, of course, can only be approximately expressed in the Roman character and English spelling : *Ganj-Ka-ghás*, Hind *Kamakher*, Beng. ; *Shunnárippallu*, Tam. ; *Kamakshi-Kasura* and *Kamanchi-gaddi*, Tel. ; *Chóra-pulla*, Mal. ; *Ganda-hanchi-khaddi*, Kan. ; *Sing-ou-miá* Burm.

A. Nardus, var. *luridus* Hooker fil. ("Fl. Brit. Ind." vii. 206) differs from var. *nilagiricus* chiefly if not wholly, by its dark purplish-brown spikes.

A sub-species *Cymbopogon hamatulus,* Hack. ("Mono. Androp." 606) is taken to be the *A hamatulus,* Nees (in Hook. and Arn. "Bot. Beechey's Voy." 244), met with by various observers in several places in China and in the Philippines.

Sub-species *marginatus* var. *Goringii*, Hack. (*loc. cit.* 607; "Bul. Herb." Boiss. vii. 642, et ser. 3, 501; Patibin in "Act. Hort. Petrop.," xix. 30, is taken as synonymous with *A. Goringii,* Steud. ("Flor." xxxi. 22) and *A. Schœnanthus,* Miq. ("Ann. Mus. Bot. Lugd. Bat." ii. 220; Franck. et Savat. "Enum. Ph. Jap." ii. 191). It has been found at various places in China, Luchu Archipelago, and in Japan.

WEST INDIAN CITRONELLA.

The oils from these grasses (citronella and lemon-grass) showing such marked differences from the East Indian, Ceylon, and Java oils it became imperative to learn something of them, and obtain authentic and quite recent specimens. For this purpose the writer described the requirement to Mr. Wm. Fawcett, Director of Public Gardens and Plantations, Jamaica, and was kindly supplied by him with fine specimens of both species. The citronella as compared with the wild *Maana* grass of the Ceylon *patanas,* differs in having wider leaves, longer spathes, and looser panicles; differences which are probably due to climatic conditions and cultivation.

LEMON GRASS.

The large, coarse, glaucous grass commonly known by this name is the *Andropogon citratus* of De Candolle. It was founded by him on a flowerless plant cultivated as a specimen in the Montpellier Botanic Gardens. It is probably the plant figured and described by Rumphius ("Herb. Amboinense," vi. t. 6, fig. 2). Wallich figured it ("Plant. As. Rar." iii. t. 280) under the name *A. Schœnanthus,* Linn. Hackel says, from the description, it may be either *A. Nardus* or *A. Schœnanthus,* but describes the Ceylon variety as *A. citratus* var. *Thwaitesii,* characterised by the spathes being from one-half to twice as long as the peduncle, and having two pairs of homogeneous spikelets and one heterogeneous in the long-pedicelled spike. These characters are found constant by Henry Trimen ("Handbook Flor. Ceylon," v. 246), and he finds the Ceylon plant has much narrower leaves than some Khasian growths.

Ferguson ("Grasses Indigenous to Ceylon," 32, No. 116) describes it as *A. citratus,* DC., cultivated for "lemon-grass oil." Watt ("Dict. of Econ. Prod. of India," i. 242) cites for it *A. Schœnanthus,* Wall, which Hackel refers to *A. Nardus* var. *grandis,* and says it is "largely cultivated in India, Ceylon, and the Eastern Archipelago, *rarely or never flowering*;" he adds that in Ceylon it is called "Penguin." Dr. Trimen (in a MS. note found by Sir J. D. Hooker) described it as bearing the name *sera,* "which is the Ma-

lay name for *A. Schœnanthus, A. citratus* (?) var. with narrow leaves. This is grown in native gardens. . . . Not known to flower." The late Dr. Dymock, of Bombay, stated he had "seen it in flower more than once." There is no specimen named *A. citratus* in the Peradeniya Herbarium, but Thwaites, under *A. Martini* refers to "Lemon oil" as derived from *A. Schœnanthus,* adding that it "rarely flowers."

Ferguson (*l.c.*) says of this grass: "The centres of the leaf-buds are sold in every bazaar in Ceylon, and I believe it to be the plant figured and described by Rumphius. About twenty years ago Mrs. Winter, of Badegama, near Galle, sent me a specimen in flower, and informed me it was the first flower that had been seen for twenty years. After several years' careful cultivation in the circular walk of the Botanic Garden several plants of it flowered in January, 1878, from which I secured good specimens."

A. citratus is a native of Bengal, and is more or less cultivated all over India (Royle, Illust. Bot. Him. Mts." i. 442), but for the distillation of the oil on a large scale only on the Malabar coast in Travancore, on the northern slope of the mountains north of Ajengo ("Pharmacographia Indica," vi. 564). It is widely distributed in Singapore, various islands of the Indian Archipelago, Ceylon, the Cameroons, the West coast of Mexico, Brazil, and the West Indies, but in many parts it exists in varieties (Hackel makes four varieties of the mother-species), doubtless the result of climate, soil, &c.

The shipments of lemon-grass oil from Cochin, on the coast of Malabar, during the last few years were as follows:

Season	Bottles	Season	Bottles
1891–2	17,400	1897–8	37,800
1892–3	22,356	1898–9	39,456
1893–4	27,984	1899–1900	33,504
1894–5	28,440	1900–1	33,196
1895–6	36,840	1901–2	27,864
1896–7	36,000	1902–3	33,684

The bottles are common wine-bottles of about 620 grams capacity. They are packed in cases containing one dozen in each case.

In Java the oil is called *Sirch,* but this name may also apply to *Tetranthera citrata,* a Javanese plant of very similar perfume.

In Mexico a beverage called *Te Limon* is made from lemon-grass.

THE WEST INDIAN LEMON-GRASS

has not yet been identified botanically with any certainty, but a specimen kindly supplied to the writer by the Director of the Botanic Gardens, Jamaica, (Mr. Wm. Fawcett), has been forwarded to the Kew Herbarium.

The oils of both the West Indian lemon-grass and citronella grass have been examined and reported upon by Mr. Cousins (Government Chemist in Jamaica), Messrs. Schimmel & Co., of Miltitz, and Mr. Ernest J. Parry, B.Sc., of London. All these chemists reported favourably on both oils, but found the physical properties of both to vary considerably from the Oriental product

(*vide* "Schimmel's Reports," THE CHEMIST AND DRUGGIST, and "Jamaica Bulletin of the Department of Agriculture"), the plants being sub-species, varieties, or forms of the mother-plant, and climatic conditions also exercising their influence on the secretions of the organs of the plants.

The West Indian grass oils will not for all purposes take the place of East Indian oils, by reason of some of their physical properties, but for certain manufacturing purposes they are admirably adapted, and an extension of their cultivation on a commercial scale should by all means be encouraged in our West Indian possessions, as, I believe, is the opinion of Sir Daniel Morris, of the Imperial Department of Agriculture for the West Indies, and Mr. Hart, of the Botanical Gardens at Trinidad. Mincing Lane brokers also have reported favourably on the lemon-grass and citronella oils from tbe West Indies, especially as, being distilled under the supervision of Government chemists, they can be shipped in a state of reliable purity—a very important consideration, and one which only applies to the oils specially distilled in Java.

The other grasses (vetiver and palma rosa) will be submitted to similar examination and reported upon when the writer has obtained from competent botanists the necessary material from the different places of growth.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, III.*

(*Continued from Bulletin for August.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

SEASONAL INFLUENCES ON LATEX.

No theoretical consideration need interfere with the recognition of any relation which can be proved to exist between the amount of latex or of rubber obtainable from Castilloa and the climatic conditions under which the trees are found. The most direct evidence of such climatic influence is to be found in the seasonal changes in the latex. Such differences in the rubber content of the milk at different seasons has received little attention from recent writers, though it is not a new fact, since a detailed statement was published by Collins over thirty years ago :

> In Nicaragua it is found that although the hule yields the juice at all seasons, the most favorable season is April, when the old leaves begin to fall and the new ones appear. During the rainy season, from May to September, the richness of the juice diminishes. From that time to January the rain diminishes and the milk increases in richness, and the tree prepares to flower. The fruit appears in March, during which month and the succeeding one the milk is at its richest. The yield of caoutchouc contained in an equal quantity of milk would in April be 60 per cent. more than in October.**

* Extracts from U.S. Department of Agriculture, Bull. No 49, Bureau of Plant Industry.

** Report on the Caoutchouc of Commerce, 1872, p. 15.

The increased richness of the milk in the dry season seems to be recognized in all districts where the dry season is long enough to permit the effect to become appreciated, but in localities where the dry weather in which tapping can be done is short there is at once less difference and less opportunity for it to become evident. Where the dry season is long, as at La Zacualpa, the flow of milk becomes small and tapping is deferred until some rain has fallen, when the quantity and quality of the milk are both at their best. The popular idea is that as the dry season advances the milk becomes too thick to flow, and that during the rainy season it becomes too poor in rubber to pay for tapping. The fact that the latex becomes richer during the dry season does not prove, of course, that the additional percentage of rubber in a measure of protection against the dry weather. It may be that the rapid growth which goes on in the rainy season uses up the rubber, while the cessation of growth in the dry season permits it to accumulate. This possibility does not, however, exclude the other, but seems rather to strengthen it, since there are other reasons for believing that the possession of latex is an advantage in the struggle against drought. Several such facts were noticed during a recent visit to southern Mexico.

LATEX IN DESERT PLANTS.

The plants able to make the most vigorous growth and put out flowers and new leaves at the end of the dry season, even in the cactus deserts about Tehuantepec, belong to the genus Jatropha and are near relatives of the Ceara rubber tree, *Manihot Glaziovii.* Also Prof. H. Pittier says that on the dry Pacific slope of Costa Rica the Ceara rubber tree produces rubber, but refuses to do so in the humid district of Turrialba, although it thrives well there.

In the cactus desert about San Geronimo to the north-east of Tehuantepec is another euphorbiaceous plant with naked green stems a yard or more in length and reddish unsymmetrical flowers. The stems are rich in a milky juice, which rapidly coagulates into a substance much like rubber, but lacking elasticity. The plant was quite leafless, but was blossoming at the end of the dry season. After the milky Euphorbiaceæ, the most flourishing desert plants were the Apocynaceæ, also with milky juice. The leguminous plants of the desert do not contain latex, but they are noted for their richness in gums and resins, which are similarly formed and may have similar functions in the plant economy.

The most striking suggestion of the utility of latex as a protection against drought was noticed in a cactus of the genus Mammillaria, found nestling in the crevices of the bare, black rocks of the fiercely heated hillsides about Tehuantepec. The Mammillarias differ from all other members of the family in having a thick, milky juice, which becomes very sticky between the fingers, though showing no signs of elasticity. It will be difficult to avoid the conclusion that in this instance the milky juice is the special character which has enabled the Mammillaria to excel all its

relatives in resistance to desert conditions of extreme heat and dryness.

A step in the same direction seems also to have been taken by a large, straggling Opuntia found near San Geronimo. Instead of the watery juice found elsewhere in this genus, a knife-cut brings out a thickish, opalescent sap, which rapidly coagulates into a somewhat resinous substance and quickly seals over the injury.

WATER STORING AS A FUNCTION OF LATEX.

As already stated, the recognition of a relation between latex and dry weather has been hindered rather than helped by the attempt at framing a theory of the use of latex to the plant; but a few writers have appreciated such facts as the above, and have been inclined to look upon the storage of water as the long-sought general function. The following extract affords an instance:

If the formation of laticiferous tubes has been called forth in all plants possessing them to perform a common function, then I am inclined to think the idea of their serving as channels for holding water in reserve as one of the most plausible. Laticiferous plants are markedly characteristic of tropical regions, where transpiration is great. The development of a system of tubes running throughout the plant to be filled with water during the wet season and then to be gradually drawn upon during times of drought is intelligible.

Warming, in a paper in the Botanical Gazette for January, 1890, entitled "Vegetation of Tropical America," mentions lianas and other plants of tropical forest and scrub as often laticiferous, and says: "Most likely latex serves several purposes, and one of them, I suppose, is to supply water to the leaves in time of need when transpiration becomes too profuse."

From our experiments in Ceylon we found that the quantity of latex extractable from incisions in the trunks of Hevea trees varied considerably with the time of the year and seemed to depend largely upon the available moisture in the soil. After heavy rain the exudation of latex is much more copious and thinner, looking as though the vessels had become surcharged with water.

As the necessity for a reserve of water increased, the laticiferous system would tend to become more extensive and more intimately associated with the surrounding tissues. The genus Euphorbia chiefly inhabits dry regions and is one of the richest in latex.

This view does not explain the proteid or starch grains of latex, yet I think it is one to be borne in mind in studying the rôle of latex in plants, and hitherto it has in the main been disregarded. If latex does serve as a water reserve, then perhaps it is chiefly valuable for the growing organs.*

This view has, however, met with no general acceptance, and has obvious difficulties, the most important being that the amount of water actually stored or present at one time in a tree like Castilloa would not long suffice for necessary transpiration. It avails little for such a plant to store unless it is also possible to husband the supply. At present, however, there seems to be no practical suggestion of means by which latex rich in rubber could better assist either in storing the water or in preventing transpiration, but of these alternatives the facts seem to be much more in favour of the latter. Apart from the slight increase due to growth, the contents of the trunk must remain of approximately the same volume. The increased pressure to which is due the increased flow of milk after the rains begin does not require a large increase of

* Parkin, Ann. Bot., 14: 212–213, 1900.

the volume of liquid in the tree, and is in all probability greatly assisted by its greater fluidity, which enables it to flow longer distances to the cuts, the capillary friction being decreased. The greater humidity of the atmosphere would also tend to the continuation of the flow in the rainy season by preventing the drying or the coagulating of the surface of the cuts, though the importance of this factor has not been determined.

That the increase of the rubber content of the latex serves as a protection against drought is also rendered somewhat more probable by the fact that Castilloa has several characters serving the same purpose. The development of hairs upon the branches, buds, scales, leaves, flowers, and fruits is much greater than is usual among related plants. The self-pruning of the branches and the rapid covering of the scars are also exceptional and of obvious utility in reducing transpiration, and the prompt falling of the leaves in situations where the water supply becomes deficient shows even better the sensitiveness of Castilloa to drought.

SIGNIFICANCE OF MULTIPLE TAPPING.

The latex problem acquires new interest from the recent demonstration that Hevea, at least, continues not only to yield milk by the daily renewal of the wounds, but that the quantity actually increases for several days. This might seem to favour the idea that the latex has a nutritive function, the additional quantities being assembled, as it were, to repair the injury. On the other hand, the supposition that the rubber hinders evaporation would also work equally well and affords the additional suggestion that the greater evaporation from the wound may assist in collecting the rubber about it, the yield increasing as the widening of the wound increases the surface of evaporation until the available supply of latex has been depleted.

CLIMATE AND RUBBER PRODUCTION.

A CONTINUOUSLY HUMID CLIMATE NOT NECESSARY FOR CASTILLOA.

The study of Castilloa furnishes evidence that with this tree there is a relation between climate and rubber production, and that this relation is the opposite of that commonly supposed to exist.

The vast quantity and high quality of Para rubber have naturally given Brazil the chief place in the thoughts of those interested in rubber, and it is one of the best established traditions of the subject that the native home of rubber is in the vast, periodically overflowed valleys of the Amazon and its tributaries; and the common failure to appreciate the diversity of the rubber-producing trees gave this idea very great acceptance.

Practical experiments in Central America soon showed, however that Castilloa will not thrive in swamps or where the drainage is deficient and this fact is generally noted as a cultural difference between Castilloa and Hevea, though the need of continuous humidity for Castilloa is still insisted upon. The point has even

been carried so far that some of the companies doing business on the Isthmus of Tehuantepec, where there is a very distinct dry season, still feel it necessary to omit this fact from their prospectuses or to represent their plantations as always moist. The incorrectness of this claim not then being realized, the extent of the dry season of the west coast of Guatemala and the adjacent Soconusco district of Mexico was observed with much interest.

GREATER ABUNDANCE OF CASTILLOA ON THE DRIER PACIFIC SLOPE.

The total rainfall of a place affords but the slightest intimation of its climate in relation to vegetation. A sudden, heavy shower may wet the soil much less than the same amount of water falling as a steady rain, and in the supply of water to plants the difference is even greater; the period during which the atmosphere and soil are moist is of importance to them, but not the amount of water which patters off their leaves or falls into the rain-gauge. Humidity even to the point of saturation for six months may be of no avail to plants unable to survive an equal period of drought. The lowland forests of the west-coast districts of Guatemala and southern Mexico, while composed in the main of the same tropical elements as those of eastern Guatemala, yet showed a striking deficiency of plants requiring continuous humidity.* Nevertheless wild Castilloa seems to have existed in the past as in the present in far greater abundance, the wild product having long been an article of export in quantity far more considerable than from the eastern districts.

FREER FLOW OF MILK IN DRIER REGIONS.

A second fact contrary to the popular supposition that rubber production is confined to continuously humid climates was encountered when it was found that, in spite of the greater dryness, the milk flows down from the rubber trees of Soconusco with a freedom unknown in eastern Guatemala, where it merely oozes out into the gashes made by the "uleros." Dr. Paul Preuss, who studied rubber culture in Trinidad, Mexico, and Central America for the German Colonial Society, did not see rubber flow down from the wounds made in tapping, and seems to have left America in some doubt as to the reality of this phenomenon. He explains that the milk of Castilloa behaves very differently from that of other rubber trees. The "fishbone cut" to which he had been accustomed was found in Trinidad to be useless with Castilloa, since the milk flowed out as a liquid only in the first few drops and soon turned into a pulpy mass, which remained in the grooves and had to be wiped out with the finger. Dr. Preuss says:

In a Castilloa plantation near San Salvador the manager stated, on my inquiry, that there are hule trees the milk of which is completely liquid and others of

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* Such are the filmy ferns, or Hymenophyllaceæ, and forest species of Selaginella; also many Orchidaceæ and Piperaceæ, largely absent from the forests between Ayutla and Tapachula, and also from the vicinity of La Zacualpa. Moisture-loving plants increase with altitude as the more humid coffee districts are approached, but at no lowland locality visited do they exist in any such abundance as in the forests of the valley of the Polochic River, in eastern Guatemala.

which the milk is thick and does not run down. I had both kinds of trees pointed out to me, but could recognize no difference in trunk, leaves, or fruits. All the trees, which I tapped later, always showed the thick milk.

In Guatemala, however, trees were pointed out to me on two plantations which, with exactly the same appearance in leaves, fruits, habits, etc., still had a completely different behaviour. On tapping there flowed out in abundance a thinly liquid milk, which however, contained no rubber, or only very small traces of it. Of such trees there were many on both plantations. They had been specially marked, and were never tapped ; naturally their seeds were also not sown for new plantations. The statement that the milk of Castilloa, that from which g od rubber can be obtained, runs down the trunk into vessels, I have often heard asserted with positive assurance. I have never been able to convince myself of it, and can only suppose that it is a case of two different varieties, with one of which I have not become acquainted.

DECREASE OF MILK WITH ALTITUDE AND CONTINUOUS HUMIDITY.

That rubber milk is obtained with greater freedom on the drier western coast shows that continuous humidity is at least not indispensible, but it does not prove that the larger production is due to the drier climate. There may be, and probably are, differences in the trees of the two regions, though these have not been detected. But that there is a climatic element even on the west coast is made plain by the fact that as the coastal plain is left behind and the slopes increase in altitude and humidity the production of rubber gradually declines. At an altitude of about 1,800 feet on the Esmeralda coffee estate, only a few miles from La Zacualpa, wild Castilloa trees apparently normal in other respects yielded milk very sparingly, while at an elevation of 2,500 feet no milk dropped from the cuts. Castilloa trees grew vigorously and attained a diameter of 15 inches in twelve years at "Quien Sabe," in the coffee district above Tapachula. The trees grow naturally up to 1,500 feet and beyond. Above 1,000 feet the rubber gathers do not expect to find much rubber. Trees planted at an altitude of 2,000 feet from seed brought from the coast do not yield rubber.

(To be continued.)

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House, on Tuesday 16th August, 1904, at 11.15 a.m.: present, His Excellency Sydney Olivier, presiding, His Grace the Archbishop, the Director of Public Gardens, the Island Chemist, Hon. H. Cork, Messrs. C. A. T. Fursdon, C. E. deMercado, J. W. Middleton and the Secretary, John Barclay.

A letter from the Colonial Secretary was submitted with regard to the Agricultural Reference Library setting forth the instructions given with regard to the administration of the Library at Hope.

Mr. J. Shore applied for one of the hand gins presented by the British Cotton Growing Association for his district, and this was agreed to.

The Chemist submitted the following reports :—

(*a*) Application for admission as agricultural students by Cleveland Lindo and John Reid, recommending that they be admitted subject to passing the usual test examination.

Both had made application for admission without fees on the ground of poverty. It was agreed to admit them on payment of half the usual fee.

The Chemist stated that there were now seven students.

(*b*) *Reservoir at Hope*—Reporting that the capacity of the reservoir was 330,000 gallons, that the delivery pipe fills it in 30 hours and the outlet is a 3 inch pipe only and the new 5 inch pipe did not draw direct from the reservoir, but from the old 3 inch pipe; that it takes 70 hours to empty the tank by a new conduit and with the rate of flow enables on acre of cane to be irrigated per departmental day.

He recommended that a direct connection be made with a 5 inch pipe at a cost of £30, to enable 6 acres of cane to be irrigated per day. This recommendation was held over for consideration, when funds should be available.

(*c*) *School Gardens and Essential Changes in the Code*—Recommending radical alterations by increased points for agricultural subjects. This was directed to be circulated.

(*d*) *Instruction in Economic Botany*—Pointing out that since Mr. Fawcett has found himself unable to continue to give instruction in Economic Botany to the agricultural students, and as Mr. Teversham had yet no special local knowledge on the subject, it might be necessary to add a new officer to the staff of the Botanical Department, as this subject was necessary to the students' course.

The Archbishop said that first a substantial agreement should be come to as to what teaching is required, second that the work should be so organized that they should utilise for that purpose to the full extent the best ability of the men belonging to the Botanical Staff, third that they must secure the co-operation of Mr. Fawcett and Mr. Cousins and enough of flexible connection with the Jamaica College to secure proper agricultural teaching for that institution, and in such a way that they should not add men to the staff and that the heads of departments should not be called on to do elementary work.

The Chairman read a letter from the Jamaica Schools Commission asking that arrangements should be made for scientific agricultural teaching to be given at the Jamaica College.

After considerable discussion the Board appointed a Committee consisting of: the Chairman, Mr. Fawcett, Mr. Cousins, Mr. deMercado, Mr. Middleton, to meet to consider the matter of the teaching of economic botany and the matter of secondary school classes.

(*e*) *Borers in Sugar Cane*—Asking permission to print a leaflet for distribution, on practical measures for reducing the ravages of these pests. It was agreed that it might first be ascertained whether there was such a publication of the Imperial Department of Agriculture, and, if so, that a

supply should be obtained if the matter was suitable for the purpose here.

(*f*) *New buildings at the Laboratory*—Reporting that the work had commenced on August 10th and that he had sent on requisition to the Crown Agents for the experiment still and boiler from a Glasgow firm whose quotation was £130; that a refrigerator would come too expensive, but he had designed a cool chamber to work with ice, and that he received authority to purchase for £12 10s. a second-hand 20 gallons still, fire heated, which had cost £25.

(*g*) *Term's Work: mid-summer 1904*—Reporting that two students had completed their course, and wanted experience on a property for a year, and that he would be glad if any member of the Board would assist in this way. This was directed to be circulated.

(*h*) *Fermentation Work*—Submitting Mr. Allan's report since the last meeting of the Board; and asking that the Public Works Department be requested to prepare the plans and estimates for alterations at Denbigh Estate for a special lock-still at a cost of £220 to £250; that authority be given to print a special bulletin on Jamaica rum at the cost of the Sugar Industry Fund. He was asked to draft the special bulletin to be submitted first to the Board. This was directed to be circulated.

(*i*) *Work of Superintendent of Sugar Experiments.*

(*j*) *Mr Teversham's lecture at Port Maria*—Stating that he had suggested that Mr. Teversham should work up the lecture into three short articles for the Agricultural Journal. This was directed to be circulated.

The Secretary submitted a report *re* cotton industry, stating that as directed he had arranged for a vigorous cotton propaganda on the Pedro Plains, that Mr. Cradwick had already held a meeting in conjunction with the Black River Agricultural Society, had distributed Egyptian cotton seed and leaflets on cotton cultivation and had arranged to return to the district in September; that Mr. C. G. Farquharson at Black River had agreed to buy all the cotton offered within the next two years at a price to be fixed by the Board, at the same time not restricting anybody from selling elsewhere; that Egyptian cotton grown by the settlers of the Pedro Plains, collected by the Rev. C. T. Rickards, had been ginned by Mr. Fursdon at Hartlands, that the cotton looked poor, as it had evidently been picked before it was ripe but it had however ginned out a high proportion of lint, and asking authority to ship this ginned cotton to London; that he had arranged with Capt. Constantine who had kindly consented to carry it freight free to Southampton; that he had examined the two hand cotton gins salvaged from the S.S. "Costa Rican" and had found them covered with rust, due to the action of chemicals which formed part of the cargo, besides the action of the salt water; that on the authority of the Colonial Secretary he had

sent the gins to the Railway work shops to be examined, reported on and put in order; that the British Cotton Growing Association had been so good as to send two other hand gins to replace these.

It was reported that Mr. Morais of Kingston had cotton seed for sale and the Secretary was asked to see him on the subject.

The Archbishop said he was going to the Pedro Plains and would like to speak on the subject of cotton if the Secretary would give him the outlines to work on.

The Board agreed that the Secretary should send on the cotton to London, and should also send the cotton from the Prison Farm.

The Chairman submitted the remarks of the members of the Board on Criollo Cocoa and read a minute from Mr. J. V. Calder on the subject. After discussion it was resolved to recommend instructors to be cautious in advocating the planting of this varietyof cocoa in districts other than where it was seen growing hardily and luxuriantly at present, as until they had figures on the net profits per acre, to show superiority to other varieties it was premature to advocate its cultivation everywhere.

The Director of Public Gardens submitted reports as follows:—

(*a*) Mr. W. J. Thompson on his recent visit to school gardens at Mount Fletcher, Clifton and Content.

(*b*) Mr. Thompson's visits to school gardens at Bethesda, Woburn Lawn, Somerset &c.

(*c*) Mr. Thompson's visit to Trinity Ville, Morant Bay, Hector's River, Manchioneal, Port Antonio, Buff Bay, &c., *re* small holdings competition, &c.

(*d*) Mr. Thompson's visit to Yallahs district.

(*e*) Mr. Cradwick's work for July, reporting that 10,000 Criollo plants had been planted by settlers in Hanover during the past 18 months.

(*f*) Mr. Cradwick's itinerary from 23rd August to November 10th.

(*g*) Mr. Cradwick's reports, Hanover and New Market Shows.

(*h*) Inspection by Mr. Palache of school gardens at Snowdon, Manchester.

(*i*) Work of Hope Experiment Station.

(*j*) Mr. W. J. Thompson on manurial plots of bananas at Burlington and Orange Hill.

(*k*) Apprentices at Hope ready for employment.

(*l*) Information on the use of cloth for shading tobacco.

All these were directed to be circulated.

Mr. Fursdon said that he had seen a notice in the newspapers that there was a disease killing off cattle around Walker's Wood.

The Secretary stated that he had been to St. Ann's Show and had heard nothing of the matter, but he would write prominent penkeepers there on the subject.

The Chairman said that this was the last occasion on which he would have the pleasure of presiding over a meeting of the Board. This was a matter of great regret to him and he wished to express his acknowledgments to the members for their valuable co-operation

in the work of the Board at much cost of time and labour to themselves for the kindness and support they had shown him as Chairman. The Board had done a considerable amount of useful work and he had no doubt would continue to do so. The Board took the place of the head of an Agricultural Department and such an organisation must continue to exist and to carry on its present services until such a Department can be formed. He hoped that Sir James Swettenham would take the Chairmanship of the Board when he assumed the Government. The Governor is in a position to do more in pushing the work of the Board than is possible for the Colonial Secretary under the constant pressure of his official work. He intended to leave his opinion on this subject on record for Sir James Swettenham's consideration. He again thanked them and expressed the pleasure which it had been to him to be associated with them and preside at their meetings.

Mr. deMercado said that they were all sorry to part with Mr. Olivier. It had been a pleasure to act on the Board with him as Chairman. They had found in him a Chairman, who always came to the Board with every subject well considered, and they were enabled to carry on the work in an efficient way, owing to the attention given by him to all the work of the Board. It was a subject of considerable surprise that Mr. Olivier should be able among all his arduous duties to take the immense amount of trouble involved in this work and he for one felt, and he thought he expressed the feelings of the Board, that the success of the Board of Agriculture had only been made possible by the very great interest and the great effort and the immense amount of work the Chairman had given to the business of the Board. He hoped they would have the chance of renewing their very pleasurable acquaintance with him.

The Chairman in acknowledging the kind expression of the appreciation of the Board said that the Board had been a most efficient and satisfactory combination to work with because of the extensive variety of the interests and qualifications of its Members in direct or indirect connection with Agriculture. They had four leading practical planters, Mr. Calder, Mr. Cork, Mr. Fursdon and Mr. Shore representing all the principal branches of Agriculture; they had Mr. deMercado representing its commercial interests, and Mr. Middleton representing commercial and manufacturing interests. Besides this they had the technical members of the Board, Mr. Fawcett and Mr. Cousins; they had connected themselves with Education through the Chairman of the Schools Commission and the Superintending Inspector of Schools, and they were in close touch with the Jamaica Agricultural Society through their joint Secretary.

[Issued 10th October, 1904.]

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BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. NOVEMBER, 1904. Part 11.

EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

CONTENTS:

PRICE—Threepence.

A Copy will be supplied free to any Resident in Jamaica, who will send name and address to the Director of Public Gardens and Plantations, Kingston P.O.

KINGSTON, JAMAICA:
HOPE GARDENS.

1904.

JAMAICA.

BULLETIN

OF THE

DEPARTMENT OF AGRICULTURE.

Vol. II. NOVEMBER. 1904. Part 11.

EXPORT OF BREADFRUIT.

Anthony Bean, Esq., Holstein, Spring Hill, P.O., to Director of Public Gardens and Plantations.

28th September, 1904.

Dear Sir,

I have just read in the Bulletin for September, 1904, at page 214 about the shipping of breadfruit from this Island to the other countries.

Pa: 2. "No other similar attempt has been made, so far as records are known to us."

I am in a position to say that the late Rev. Wm. Smith, Rector of Portland, when he was Curate at Golden Grove, St. Thomas-ye-East, occasionally shipped breadfruit to his friends in England, by *sailing ship*, from Port Morant.

He used to thoroughly roast the fruit and pack it, *unscraped*, in barrels. It always reached its destination in good condition and was duly appreciated by the recipients.

When required for use it was heated in an ordinary kitchen oven, then scraped and sent to table.

Yours faithfully,

(Sgd.) ANTHONY BEAN.

CHEMICAL NOTES ON "BASTARD" LOGWOOD.*

By BENJAMIN C. GRUENBERG AND WILLIAM J. GIES.

[From the Bulletin of the Torrey Botanical Club, 31 . 367-377. July, 1904.]

During the past few years the growers of logwood in Jamaica have been greatly disturbed by an apparent increase on their properties of an unmerchantable variety of the plant known as "bastard" logwood.† The exportation of this wood along with real logwood has served to condemn all the logwood from the districts which have shipped it.‡

"Bastard" logwood differs from the genuine varieties, from the

* From the New York Botanical Garden, New York. Some of the chemical work was done in the laboratory of physiological chemistry of Columbia University.

† Fawcett: Bulletin of the Botanical Department, Jamaica, 3: 179. 1896.

‡ Clipping from a Kingston, Jamaica, newspaper, sent to Dr. D. T. MacDougal by Mr. William Fawcett (September, 1901.)

dyer's standpoint, in yielding little or no hematoxylin, but, instead, a yellowish-green pigment which is of no value and which, when admixed with the commercial extract, reduces the characteristic tinctorial properties of the latter. Chips of the "bastard" logwood present a yellow, pale pink, white or even chocolate-coloured surface instead of the dark red or deep purple, bronze-tinted colour of the best Jamaican or Mexican logwoods of commerce. There appears to be considerable uncertainty, even when the trees are cut down, as to whether a tree is really a "mulatto" ("bastard") tree or not. What is known as a "mulatto" tree is frequently dark enough when first cut to lead one to believe that it is a good redwood tree, but instead of darkening with age as all the good wood does, it remains the same colour or becomes lighter rather than darker. The "bastard" tree seems to be perfectly dry, and even when the chips are soaked for a long time in water, they give out no dye.*

Various theories have been advanced to explain the apparent increase in the "bastard" logwood in Jamaica. Professor F. S. Earle, after a thorough study of the situation in Jamaica, came to the following conclusions :†

1. "Logwood is a variable plant showing marked differences in form, colour and texture of leaf ; time of blooming ; form and extent of ribs on the trunk ; colour of bark and especially in the colour and dye-producing quality of the heart-wood. Four well-marked varieties are said to be recognized in Honduras and three are usually recognized in Jamaica, but there are many other intermediate forms."

2. "Bastard" wood is not the result of disease or of any lack of vigour. The trees producing it are perfectly healthy and normal.

3. "It is not the result of soil or climatic conditions, since 'bastard' and normal trees are found growing side by side under absolutely identical conditions."

4. "It is not the result of immaturity. Aged trees may produce 'bastard' wood, while in normal trees the heart-wood, as soon as formed, contains a good percentage of hematoxylin. These facts seem to point to heredity as the probable cause of the trouble. That is, that certain trees produce only 'bastard' wood because they grow from the seed of a 'bastard' tree ; or in other words that 'bastard' logwood represents a variety of *Haematoxylon campechianum* that normally produces little or no hematoxylin, just as one Honduras variety has smaller, shorter, thinner and lighter coloured leaves."

Some time before Professor Earle made his investigations in Jamaica we began, at Dr. MacDougal's suggestion, a comparative study of logwoods from that island, in the hope of finding definite chemical differences, other than purely tinctorial ones, between "red logwood" and the "bastard" variety. Unfortunately our

* Cradwick : Report to the Chairman of the Experiment Station. Kingston, Jamaica 1902 (April 4.)

† Earle : Journal of the New York Botanical Garden, 4 : 3, 1903; reprinted in Bulletin of the Department of Agriculture, Jamaica, 1 : 30. 1903.

work in collaboration was soon unavoidably interrupted. We present here very briefly, however, such of our notes in this connection as may be of general interest.

ELEMENTARY COMPOSITION OF HEART-WOOD.—Elementary analysis of typical samples of (1) the red logwood of commerce (2) a "bastard" variety somewhat resembling it and (3) a second specimen of the "bastard" type yielding hardly any pigment to water gave the following results:—

TABLE I.

PERCENTAGE ELEMENTARY COMPOSITION OF SUBSTANCE DRIED TO CONSTANT WEIGHT AT 110°C.*

	I.			II.			III.		
	"Red" Logwood.			"Bastard" (medium grade.)			"Bastard" (poorest quality.)		
	C†	H	Ash	C†	H	Ash	C†	H	Ash
1	51·91	5·98	1·80	51·45	5·83	1·59	51·04	5·67	2·03
2	52·00	5·80	2·06	51·77	6·03	1·68	51·35	5·74	1·86
3	52·12	5·6	1·71	51·45	6·03	—	51·00	5·58	—
Av.	52·01	5·84	1·86	51·56	5·96	1·63	51·13	5·66	1·94

SUMMARY OF AVERAGES.

	I.	II.	III.	General Average.
Carbon ...	52·01	51·56	51·13	51·57
Hydrogen ...	5·84	5·96	5·66	5·82
Ash ...	1·86	1·63	1·94	1·81
Oxygen‡ ...	42·15	42·48	43·21	42·61

The most significant feature of these results is the decreasing amount of carbon in the "bastard" wood. The differences are too slight to warrant any emphasis, but are such as might be due to a lower percentage of hematoxylin, which is a pigment of high carbon (and low oxygen) content—$C_{16}H_{14}O_6$

The data of the second series of analysis, given in TABLE II, show that the wood was not decomposed in the process of drying to constant weight at 110° C. (first series) and that, therefore, the previous results were not influenced by that procedure.

GENERAL COMPOSITION OF SEEDLINGS.—In TABLE III we present the results of some analyses of seedlings of "red" logwood

* Only heart-wood was employed in this work. This was converted into sawdust and only such portions as passed through a very fine sieve were taken for analysis. The methods of analysis were those which are now in general use.

† The figures for carbon and hydrogen are calculated (from the data of direct analysis), for *ash-free* substance.

‡ Calculated, by difference, for *ash-free* substance.

TABLE III.

PERCENTAGE ELEMENTARY COMPOSITION OF SUBSTANCE DRIED TO CONSTANT WEIGHT AT 20 C.°

	I.			II.		
	C	H.	H_2O	C	H	H O
1	46·90	5·40	7·95	46·58	5 28	7 97
2	46 98	5·24	—	46·87	5·45	—
3	47·08	5·20	—	46·58	5·45	—
Average.	46·99	5 28	7·95	46·68	5·39	7·97

and of the "bastard" variety. The condition of the seedlings at the time of analysis is shown in FIGURE I. The outward appearance of the two kinds of seedlings was practically the same. Likewise, the differences among the figures in our table for general chemical composition are too slight to warrant any other conclusion than that the seedling metabolism was, in general, essentially the same in both varieties. The analyses were made 12 months after seeds were planted.

TABLE II.

GENERAL COMPOSITION OF LOGWOOD SEEDLINGS.*

		Water.		Solids.					
				Total.		Organic.		Inorganic.	
		Red	Bastard.	Red.	Bastard.	Red.	Bastard.	Red.	Bastard.
Leaves,	a	60·33	60·05	39 67	39·95	37·08	36·93	2·59	3·02
		59·89	—	40·11	—	37·70	—	2·41	—
	b	56·27	51·22	43·73	48·78	41 08	45·94	2 6	2·84
	c	63 57	60·68	36·43	39·32	34 72	36 50	1·71	2 82
Upper stem,	a	43·77	38·34	56 23	61·66	54·40	58·29	1·83	3·37
	b	39 06	34·01	60 94	65·99	59 08	63·99	1·86	2·00
	c	43·68	45 89	56·32	54·11	54·61	52·50	1 71	1·61
Lower stem,	a	43·19	39·99	56·81	60 01	55 62	58·32	1·19	1·69
	b	36·83	32 97	63 17	67 03	61·63	65·24	1·54	1·79
	c	43·39	44·46	56·61	55·54	55·41	54·14	1·20	1·40
Roots,	a	67·93	61 66	32 07	38·34	30 52	35 39	1·55	2·95
	b	65·32	70·58	34·68	29 42	33·20	27·70	1·48	1·72
	c	—	49·17	—	50·83	—	46·87	—	3·96

* Analyses were made by the usual drying and incineration methods. The portions subjected to comparative analysis were approximately of the same morphological location in each variety. The most significant differences seem to be the slightly larger proportion of water in the "red" wood and the relatively greater quantity of solids, especially inorganic matter, in the "bastard" samples.

CONCLUSIONS FROM THE GENERAL ANALYTIC DATA—All of the preceding analytic results make it evident that the chemical differences existing among these logwoods are quantitatively very slight. They also make it appear probable that the variations in the different samples of the wood are chiefly variations in the

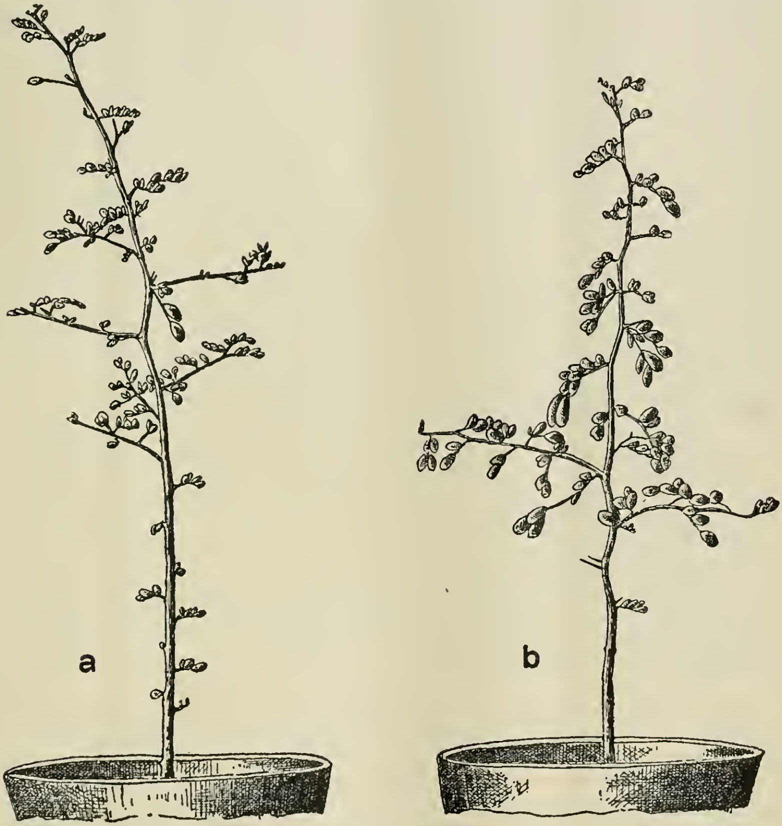

FIGURE I. Seedlings of logwood. one year old. a. "red logwood." b, "bastard logwood." Both grown from seeds obtained from "Old Hope" plantation, Jamaica.

chemical characteristics of the pigments themselves, which as is well known, possess as a rule high tinctorial qualities even when they occur in only very small amounts. Our results in this connection would also indicate that there are no striking structural differences among these varieties of logwood. They suggest, likewise, that even metabolic tendencies in these logwoods are essentially the same, varying only, perhaps, in the course of events which involve relatively slight quantities of pigment.*

TINCTORIAL DIFFERENCES.—The foregoing results having shown that the differences among these logwoods were chiefly if

* These conclusions are in harmony with those drawn from other standpoints by Professor Earle (quoted on page 242). They were arrived at independently by us and were included in our report, in December, 1902, to the Botanical Society of America before we were aware of Professor Earle's deductions. Science, II. 17 : 338. 1903.

not solely tinctorial, we next endeavour to ascertain the extent of the pigmentary variations.

Our first experiments in this connection were efforts to determine the relative tinctorial intensity of extracts of different samples of heart-wood sawdust made with equal volumes of various solvents under similar conditions of temperature, shaking, etc., from the same quantities of material dried to constant weight at 110° C.* Among the samples were several inferior qualities of red wood from dead and decaying trees.

TABLE IV gives our first results in this connection. The figures in that table denote the relative positions in a series of ten extracts—1 indicating weakest colouration, 2 the pigmentation of next higher intensity and so on to 10 showing the most decided tinctorial effect.

The shade of colour varied with each extractant, as would be expected. The following observations were made in this connection, on the colour of the series of extracts referred to in TABLE IV.

I. Water—slight yellowish-brown to deep reddish-brown.†
II. 0.2 per cent. HCl—faint yellow to orange.
III. 2.0 per cent. HCl—faint yellow through reddish brown to bright red.
IV. 0.01 per cent. KOH—chocolate colouration throughout.
V. 0.15 per cent. KOH—deep chocolate colouration throughout.
VI. 0.5 per cent. Na_2 Co_3 —chocolate colouration throughout; less than in V, greater than in IV.
VII. Saturated borax solution—faint yellow to deep reddish-yellow.
VIII. Ether—faint yellow to orange.
IX. Absolute alcohol—faint yellow to red.
X. Acetone—faint yellow through greenish-yellow to yellowish-red.
XI. Acetic ether—faint yellow to deep reddish-yellow; brighter than in VII.
XII. Chloroform—no colour in some, faint yellow in others.
XIII. Benzol—no colour in any.

TABLE IV.

RELATIVE PIGMENTATION OF VARIOUS KINDS OF LOGWOOD.

Extractant.	*A*	*B*	*C*	*D*‡	*E*	*F*	*G*	*H*	*I*	*J*
I. Water .	1	2	3	10	4	6	7	5	8	9
II. 0.2 % HCl.	1	2	5	7	6	3	4	10	9	8
III. 2.0 % HCl. .	1	2	4	3	5	6	7	8	9	10
IV. 0.01 % KOH. .	1	2	4	3	5	6	7	8	9	10
V. 0·15 % KOH. .	2	4	1	3	5	7	6	8	9	10
VI. 0.5 % Na_2 CO_3 . .	2	[illegible]	1	6	4	5	7	8	9	10
VIII. Ether. .	1	2	5	4	8	7	9	6	3	10
IX. Absolute alcohol .	1	2	4	3	6	5	9	7	8	10
X. Acetone. .	1	2	4	3	5	9	6	7	10	8
XI. Acetic ether. .	1	2	3	4	6	7	5	9	8	10
Average .	1.2	2.3	3.4	4.6	5.4	6.1	6.7	7.6	8.2	9.5

A—"Bastard" (very poor). *B*—"Bastard" (very poor). *C*—Immature wood of varying tints. *D*—"Purple" (from tree on extremely poor marly bank; tree

* Drying occurred rapidly and seemed to have no transforming effect on the dust. This fact was noted before in another connection (page 243).

† The colouration intensities are indicated progressively from 1 to 10 (see TABLE IV) Individual exceptions are not referred to.

‡ This sample contained several pigments. One of these was purplish and quite unlike any in the other samples. The pigment was especially soluble in water. It was not ordinary hematoxylin.

mature, but dead in nearly all parts, including the r o s) *E*—Immature wood of varying tints. *F*—" Bastard" (medium grade). *G*—Red (tap root of nearly dead tree). *H*—Red (tree over ripe; wood bored by ants). *I*—Red (from roots of dead tree). *J*—Red (best grade)

More important, however than the variations in the shades of colour in the extracts was the fact, already noted, that the *sequence* of colouration intensity (in extracts made under like conditions in detail in each series) *varied* with each solvent (TABLE IV). This result not only shows that the colours of the woods are not due merely to different amounts of the same pigment but also proves that the pigmentary differences are caused either by varying proportions of at least two pigments, or by the same pigment radical in more than one chemical condition—in combinations, it may be of different solubilities and stoichiometric relationships, and of different dissociable tendencies.

Relative tinctorial differences and variations are further shown in the following sample data, which indicate the quantity of water in c.c. added to 10 c.c. of 0.5% Na_2CO_3 extract (TABLE IV) in order to make the tinctorial intensity approximately the same throughout the series.*

TABLE V.

Sample of logwood.	Water added.	Sample of logwood.	Water added.
A	3·5 c.c.	C	7·5 c.c.
B	3 5	D†	10 0
F	5 5	H	10·9
E	7·1	I	12·2
G	7·1	J	17·8

The letters correspond to those in TABLE IV.

The tinctorial sequence after the above dilution is different from what it was before dilution as may be seen from the following summary:‡

TABLE VI.

	1	2	3	4	5	6	7	8	9	10
Before dilution (TABLE IV).	C	A	B	E	F	D	G	H	I	J
After dilution (TABLE V.)	A	B	F	E	G	C	D	H	I	J

*Dilution of D with an equal volume of water furnished the bases of colouration or the comparative observations.

† This colour was of the same intensity as the rest, but not the same shade. See footnote above.

‡ A similar change in sequence of tinctorial intensity after dilution was noted in other extracts, also.

The above facts are in further harmony with the foregoing conclusions regarding cause of colouration effects and relative differences.

Dilute aqueous extracts of two samples of red logwood and of one medium grade "bastard" wood all showed a similar yellow colour, by transmitted light. The shades of colour did not differ noticeably except in degree. In stronger extracts of equal concentration the first two appeared more reddish.

Treatment with alkalies, volatile and non-volatile, turned the colour of the red logwood extracts to a blood-red, passing into purple whereas in the bastard extract the shade of yellow was merely deepened, passing into the dull brown colour of faded oak leaves. Dilute and concentrated mineral acids turned the yellow of the dilute aqueous extracts of the red wood into a colour ranging from orange to bright red. In the "bastard" extract no such change was perceptible.

These differences in the behaviour of the two sets of aqueous extracts toward acids and alkalies correspond to the differences between the reactions exhibited toward the same reagents by a freshly prepared solution of the commercial "extract of logwood," and a solution four weeks old that had faded to a straw-yellow.

The chemical alterations undergone by the aqueous solution of the commercial extract are accompanied by such a decided change in colour and in chemical properties that from a comparative study of such extracts we expected to learn something definite regarding the actual differences between the pigments in the heart-wood of "red" logwood and in that of the bastard variety. We were unable, however, to do so.

Experiments were started to determine, if possible, the relations of light and of air to the discolouration of solutions of logwood extracts. In a few weeks all the preparations had been attacked by growths of *Penicillium*, *Rhizopus* and other fungi. After filtration the solutions showed no appreciable differences in shade or colour. But on diluting these filtered solutions with two parts of water and eventually with eight parts, differences were readily observed.

The solutions which had been in the light showed no change in colour, whereas those kept in the dark had become distinctly yellow. The extracts to which the air had free access manifested the greatest changes.

SOLID MATTER IN LOGWOOD EXTRACTS.—We desired to ascertain, in comparative determinations, the quantities of solid matter in aqueous extracts of the various logwoods under investigation. The absolute amount of solid substance in 100 c.c. of the extract was always small—less than 0·02 gram. In the drying process slight decomposition seemed to result and perfectly constant weights could be obtained only after a long time. Although the absolute changes in weight were only very small, the proportionate variations in quantities so slight were quite large. For these

reasons no comparative observations were attempted in this connection. The use of very large volumes of extract, to reduce the comparative effects of the variations referred to, was impracticable.

The general question of the physiology or chemistry of pigment-formation in the heart-wood was not approached at all, nor were the histological characters of the varieties compared.

There can be no doubt that "bastard" logwood is, as Prof. Earle also concludes (see page 368) a distinct variety or subspecies of *Haematoxylon campechianum,* notwithstanding the slight morphological differences that distinguish it from the "red logwood" and "blue logwood." The differences in the floral organs between

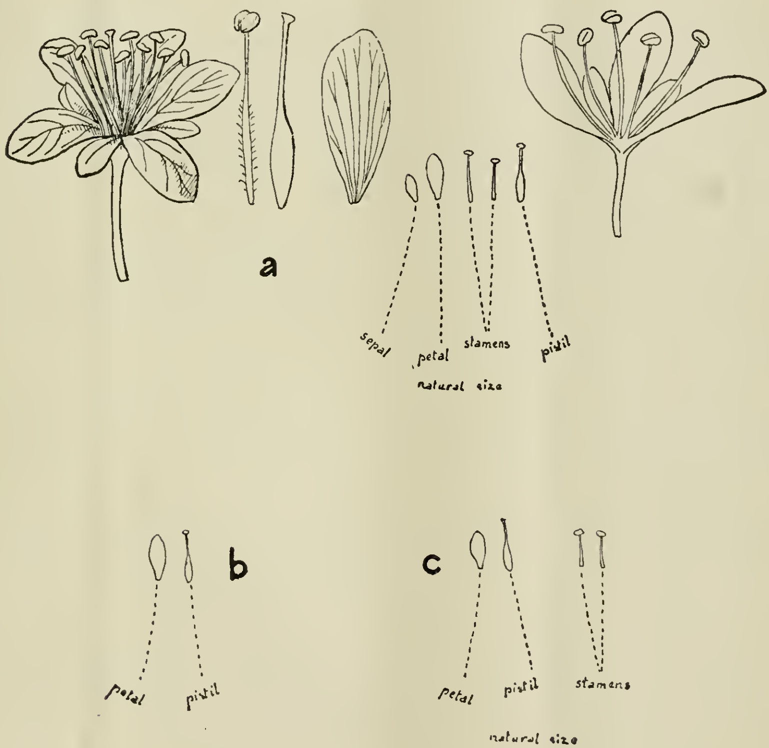

FIGURE 2 These drawings, which were made from specimens collected by Mr. William Fawcett, near Morant Bay, Jamaica, show all the morphological differences that have been observed in the flowers of three varieties : *a.* "blue logwood." *b,* "red logwood," *c,* "bastard logwood."

The petals are widest in the blue and narrowest in the bastard.

The pistil of the blue is thicker than that in the red and the bastard. The style in the bastard is slightly curved.

In the bastard the stamens are smaller than in the others, and there is less difference between them.

It does not appear from the data at hand that the differences noted exceed the ordinary individual variations for the species of *Haematoxylon.*

the three varieties are shown in FIGURE 2 which was made from drawings sent by Mr. Fawcett, of the Jamaica Botanical Gardens.

That there are species which are not at all distinguishable from one another externally, but which vary in their physiological properties, is a recognized fact,* and the "bastard" logwood may simply be a new example of the same phenomenon. A parallel case would seem to be furnished by the black locust (*Robinia pseudacacia*), the wood of which is described by Sargent† as being "reddish, greenish-yellow or white, *according to locality*"; but the yellow and white varieties occur side by side in at least one locality.

SUMMARY.

1. The most significant fact shown by elementary analysis of the heartwood of typical specimens of logwood was the lower carbon content of the poorer wood, which may be due to lower pigment content, hematoxylin being a compound containing nearly twice as much carbon as oxygen.

2. No morphological differences are discernible between red logwood and "bastard" logwood in the young seedlings.

3. Analyses of the various seedlings agreed too closely to warrant any conclusion but that the metabolism of the seedlings was essentially alike in the two varieties.

4. The chemical differences between red logwood and "bastard" logwood are very slight, and are probably due to differences in amount of pigment.

5. Extractions with various solvents gave solutions of different colours, and also of varying orders of intensity in the several series, indicating the presence of at least two pigments in varying proportions, or a pigment radical in different combinations.

6. This was confirmed by the fact that the order of colouration intensity of a series of extracts was altered by diluting with water.

7. Aqueous extracts of the two varieties of logwood gave different reactions to acids, alkalies and other reagents. The differences are parallel to those between a fresh aqueous solution of commercial logwood "extract," and the same solution after it had become discoloured on long standing.

8. Attempts to determine the conditions of the discolourations of solutions of commercial "extract," failed to yield definite results, but indicated, in general, that darkness and air are favourable to the change.

* DeVries: Mutationstheorie, 1: 122. 1901.

† Sargent: Catalogue of the forest trees of North America, 15. Washington, 1880.

INOCULATING THE GROUND: A REMARKABLE DISCOVERY IN SCIENTIFIC AGRICULTURE,*

By GILBERT H. GROSVENOR.

"Did you vaccinate your land this year?" was the startling question I heard one farmer ask another the other day. "Well, I guess," he replied. "You remember that corner field which I gave up as hopeless last year. Well, when I heard about the yeast cake the government was giving free with the promise that they'd make clover or alfalfa grow where we farmers couldn't raise anything but weeds, and thin weeds at that, I thought I'd send for several of the cakes. When the cakes came, I vaccinated the field according to instructions, planting it in alfalfa. I tell you, I 've had three whopping crops, and I 've got off that formerly worthless field five times more than I 've been getting off my best land, and I 've got some pretty good land too."

We have grown accustomed to the idea of being vaccinated. Some of our most dread diseases have been vanquished or checked by inoculation,—small-pox, diphtheria, rabies, and we hope, the plague,—but to cure sterile ground and make it bring forth fruit in abundance by inoculation is something so strange and revolutionary that we should not believe the statement were it not for convincing and irrefutable facts.

Before explaining the discovery and manner of this extraordinary process of agricultural science, it might be well to review a few well known facts in the life of plants.

One of the most important elements of the food of a plant is nitrogen, which it absorbs from the soil mainly through its roots; successive crops of grain soon drain the soil of its plant-food, and in process of time makes the richest land poor and worthless.

A good farmer partly balances the drain on his soil by using plentiful quantities of manure and fertilizer, and thus puts back much of the nitrogen which his crops remove.

We send to Chile, thousands of miles away, for help, and at much expense import from her thousands of tons of costly nitrate, though we have all about us—in the air we breathe—exhaustless stores of fertilizer. Free nitrogen forms seven tenths of the atmosphere. If we could tap and use this sea of nitrogen, we could fertilize the whole earth and keep it rich; but it has been of no use to us hitherto because we have had no means of capturing it and of putting it into the ground. Its simplicity has baffled us. Like the plenty that tormented Tantalus it has ever eluded our grasp.

We are taking the nitrogen from the soil so much faster than we can put it back that some persons have predicted a "nitrogen famine" at no distant day, and have luridly described the horrors that will fall upon us when the soil becomes so poverty-stricken that our crops of wheat and grain and rice will fail to feed the nations. While this view is of course partly imaginative, and exaggerates the nearness of the danger, the fact remains that many

* The "Century Magazine," Oct 1904.

areas in England and Europe and the eastern United States, formerly fertile, are now unproductive because the nitrogen in the soil has been exhausted.

But now man has captured a tiny germ invisible to the naked eye, which can take from the boundless store of nitrogen he has coveted and put it into the earth for him.

Ever since the time of Pliny, farmers have noticed that after a crop of peas, alfalfa or any of the leguminous plants, a heavier yield of wheat can be obtained ; thus has arisen the old profitable rule of rotation of crops.

But the reason certain plants enrich the ground while others exhaust it, remained a mystery until an enquiring German discovered some years ago that peas, beans, etc., obtained their nitrogen food not from the nitrates in the soil, but from the free supply of the air. He also discovered that these plants absorbed much more nitrogen than they could use and left the surplus in the soil. That is, beans, peas, alfalfa, clover, put back into the mother earth what corn and wheat and grain remove. The manner in which they do this is unique and another instance of the marvellous and mysterious laws by which the balance of nature is maintained.

If one digs up a healthy bean or clover plant and examine the roots, he will see a number of rounded bulbs, called nodules or tubercle, on the roots. At first sight he might imagine that the plant had a lot of sores over it, that it was diseased, or had been bitten by worms or insects. All legumes have these nodules or tubercles, varying in size from a pinhead to clusters as large as a good-sized potato. Scientists noticed that plants with good-sized nodules flourished, while plants without nodules or with very small ones looked starved and withered, and they concluded that the nodules must have something to do with the vigour of the plants. On dissecting a bulb and examining it under a microscope, it was found to be packed with bacteria. Further examination showed that it, and all nodules, consist of millions of bacteria and that these bacteria were incessantly absorbing free nitrogen from the air and converting it into forms suitable for the plant's digestion.

For want of a better term we will call the germs nitrogen-fixing bacteria.

Careful examination of the earth showed that all soil where legumes grow contain these nitrogen-fixing bacteria, in greater or less quantities ; that these organisms settle on the plants and form the colonies or tubercles on the roots. If the soil contain none of these organisms to settle on the roots, the legumes will not grow at all. Each tubercle acts as a feeder to the plant. The more numerous and larger the tubercles, the more prosperous is the plant. One might thus define a tubercle as a little factory where millions of tireless infinitesimal workers are separating the nitrogen in the air and converting it into plant-food. A celebrated German, Professor Nobbe of Tharandt, realized that if he could put into barren ground some of these organisms, or if he could

artificially present the seeds with power to develop tubercles of themselves he could make legumes grow in the most hopeless soil.

After much labour he isolated the nitrogen-fixing bacteria. He succeeded in breeding and colonizing the germs, and then proceeded to put them on the market. He advertised them widely as able to make legumes grow in the poorest soil. Naturally the announcement made a great sensation, and farmers from all quarters of the globe wrote him for sample bacteria. He sold different preparations for different crops, putting them up in bottles and calling them *Nitragin.* But the bacteria did not work the miracles promised. Seeds inoculated with them failed to develop tubercles. A few persons, to be sure, obtained wonderful results, but the vast majority of cases were complete failures. The bacteria burned themselves out and disappeared without producing a single nodule on the plants. They lacked permanence. The Nitragin was withdrawn from the market.

These two men had done a great service to mankind ; one had solved the problem of why certain plants enriched instead of drained the soil—he had isolated the microscopic agents, the myriads of organisms which would carry back to mother earth what others had stolen ; the other had shown that man could breed as many of these little helpers as he desired, but he had not been able to give them permanence, so that men could get service from them.

At this point the inventive genius of an American, Dr. George T. Moore, came to the rescue, and saved the discovery by giving it just the practical value it had lacked. Dr. Moore is in charge of the Laboratory of Plant Physiology of the Department of Agriculture, and a widely known practical botanist. He had been watching Dr. Nobbe's experiments and had come to the conclusion that Dr. Nobbe did not cultivate his nitrogen-fixing bacteria in the right way. The German's method of rearing his germ colonies resembled that of a rich father who gives his son everything he asks for without making him work for anything. As a result, when the youth is thrown on his own resources, he proves unable to earn his own living, and collapses. Similarly, Dr. Nobbe, instead of developing the natural inclination and ability of his bacteria to hunt out nitrogen for themselves, dulled and destroyed this ability by giving them large quantities of nitrogen food, in what we might call predigested form ; he so satiated them with nitrogen that they lost their ability to hunt for it themselves, and when turned out of the laboratory, were helpless. They soon consumed the store of nitrogen which they had received, but could not by themselves get any more. The nitrogen-fixing ability was gone and they perished.

Dr. Moore decided not to dull the appetite of the nitrogen-fixing bacteria by giving them all the nitrogen they wanted ; he thought he would whet their appetite, he would strengthen their nitrogen-fixing power, by exercise, by giving them in their food just enough nitrogen to make them want more and to make them strive to get

more by their own efforts. By following this principle of feeding he developed a permanent type of bacteria in his laboratory possessing five or ten times more power to fix free nitrogen than the original germs had possessed. The bacteria had gained strength, vigour, and self-reliance, and when turned out of the laboratory, prospered like all healthy bacteria. Legumes inoculated with the bacteria developed great tubercles and grew to great size even in the poorest soil.

The nitrogen-fixing power of the bacteria developed by Dr. Moore is so extraordinary that seeds soaked in the solution will sprout and produce luxurious plants in quartz sand which has been previously ignited to a red heat in order to drive out all nitrates.

Having secured a type of bacteria the nitrogen-fixing power of which was permanent, the next step was to obtain a simple means of distributing them to persons who desired to inoculate their land. Experiments showed that bacteria when grown upon nitrogen-free media will retain their high activity for a long time if carefully dried out and revived in a liquid medium. Dr. Moore also discovered that by using some absorbent, like cotton, a small piece of which will soak up millions of the organisms, and then by allowing these cultures to become dry, the bacteria can be sent to any part of the world and yet arrive in perfect condition.

Naturally Dr. Moore patented his discovery, but then he did a very unusual thing—he deeded the patent to the Department of Agriculture in trust for the American people. To be sure, his discovery had been made in the government laboratories, but thegovernment, neither morally nor legally, could claim any share in the discovery. It was indisputably his. Dr. Moore gave the patent to the people in order that all might have the free use of it. Doubtless he could have made a generous fortune if he had formed a company and exploited the patent, as the German company made a good profit from their unreliable Nitragin, which they sold at a dollar a bottle. A simple method of distributing the germs that bring fertility having thus been found, the announcement was made that the Department of Agriculture was prepared to send applicants free of charge enough inoculating material for several acres.

A portion of inoculating material as it is mailed to the farm by the government consists of three different packages. Package No. 2 contains the cotton with its millions of dried germs. Packages 1 and 3 are the media of food by means of which the farmer can multiply the germs. The department incloses explicit instructions how to use the bacteria, as follows :

DIRECTIONS FOR USING INOCULATING MATERIAL.

(METHOD patented in order to guarantee the privilege of use by the public. Letters Patent No. 755,519 granted March 22,1904.)

Put one gallon of clean water (preferably rain-water) in a clean tub or bucket and add No. 1 of the inclosed package of salts (containing granulated sugar, potassium phosphate, and magnesium sulphate). Stir occasionally until all is dissolved.

Carefully open package No. 2 (containing bacteria) and drop the inclosed cotton into the solution. Cover the tub with a paper to protect from dust, and set aside in a warm place for twenty-four hours. Do not heat the solution or you will kill the bacteria—it should never be warmer than blood-heat.

After twenty-four hours add the contents of package No. 3 (containing ammonium phosphate.) Within twenty hours more the solution will have a cloudy appearance and is ready for use.

To Inoculate Seed :

Take just enough of the solution to thoroughly moisten the seed. Stir thoroughly so that all the seeds are touched by the solution. Spread out the seeds in a shady place until they are perfectly dry, and plant at the usual time just as you would untreated seed. The dry cultures as sent from the laboratory will keep for several months. Do not prepare the liquid culture more than two or three days previous to the time when the seeds are to be treated, as the solution once made up must usually be used at the end of forty-eight hours.

To Inoculate Soils :

Take enough dry earth so that the solution will merely moisten it. Mix thoroughly, so that all the particles of soil are moistened. Thoroughly mix this earth with four or five times as much, say half a waggon-load. Spread this inoculated soil thinly and evenly over the field exactly as if spreading fertilizer. This should be done just before ploughing, or else the inoculated soil should be harrowed in immediately.

Either of the above methods may be used, as may be most convenient.

Enough germs are sent in each little package to inoculate seeds for from one to four acres. The package can be carried in your pocket, and yet does more work than several cart-loads of fertilizer. It costs the government less than four cents a cake, or less than a cent an acre, and saves the farmer thirty or forty dollars, which he would have to spend for an equal amount of fertilizer. Different cultures are sent for different crops.

The results have been surprising. If Malthus were living, he would have to revise his calculations of the time when the world will be so crammed with people that it cannot feed them.

A comparison of the actual figures of yield of two crops grown on exactly the same land, but one of inoculated and the other of uninoculated seeds is quite startling. Two patches of hairy vetch grown side by side under precisely the same conditions, yielded crops as follows : uninoculated patch, 581 pounds ; inoculated patch 4,501 pounds an increase of more than eight times. Crimson clover under similar conditions yielded : uninoculated, 372 pounds ; inoculated 6,292 pounds—an increase of nearly twenty times.

It does not require a trained scientist to apply the cultures. The

results obtained by any intelligent farmer are as wonderful as these.

For instance, take the case of a Maryland farmer who had formerly been able to cultivate only one third of his land ; he had been obliged to abandon two thirds because of the hopelessness of getting anything from it. Now, at no expense to himself and at trivial amount of labour, he had reclaimed the worthless two thirds and made it more productive than the other third. He had incerased the yield of his farm, his income, fivefold ; a generous living is now before him.

And what did it cost the government to help him so generously ? Eight cents ! The farmer had used two cakes to inoculate the seeds for seven acres, each cake costing the government four cents to manufacture.

But there are even other wonders that these little nitrogen-fixing bacteria work. It has already been explained how legumes enrich the soil by bringing back nitrogen to it. The same bacteria that increase the harvest of beans or clover or alfalfa tenfold enable the plants to leave many times more nitrogen in the soil than they would have done if uninoculated ; in other words, they make the soil many times more fertile, so that the crop of cotton or wheat or corn or potatoes planted next year is many times larger. Thus the rotating crop the year following inoculation derives an equal benefit from the inoculation. For instance a crop of crimson clover, not inoculated, added to one acre of land 4·3 pounds of nitrogen ; a crop of crimson clover, inoculated, added to one acre of precisely similar land 143·7 pounds of nitrogen, an increase of $33\frac{1}{2}$ times ; a crop of inoculated hairy vetch added to one acre 15 times more nitrogen than a crop of uninoculated hairy vetch.

Cotton planted after an inoculated crop of red clover gave an increased yield of 40 per cent. Potatoes, after an inoculated crop, yielded an increase of 50 per cent. The wheat crop increased by 46 per cent., the oats 300 per cent., and the rye 400 per cent. The table below shows the effect of inoculated legumes on various crops.

The germs can be used in any climate. It must be clearly understood, however, that only leguminous plants—beans, clover, alfala, peas lupin, vetch, etc.—are directly benefitted by the nitrogen-fixing bacteria. Where the soil is rich in nitrates, the crop is not appreciably increased by the use of the inoculating bacteria ; but where the soil is poor, the harvest is increased many times.

There is not a section of the United States which will not profit by Dr. Moore's discovery. Nearly every State has its wornout farming-land, bringing despair to the economist who laments our careless handling of the fields and who wonders how the country will support the hundreds of millions soon to be ours. The bacteria means intensive cultivation with a vengeance, and should give him hope. It is impossible as yet to calculate by how much they

will enhance the yield of our crops and of the world's crops, but the results already achieved prove that in time the gain will be enormous.

	Original yield per acre.	Yield per acre after inoculated crop.	Gain in weight.	Gain in value.	Per cent. of gain.
Cotton .	932· pounds	After red clover, 1,304 pounds	372· pounds	$44·64	40 per cent.
Potatoes ·	67·8 bushels	After crimson clover, 102·2 bushels	34·4 bushels	15·	50 "
Oats .	8·4 "	After velvet beans, 33·6 bushels	25·2 "	9·	300 "
Rye	4·5 "	After peas, 23·5 bushels	19· "	9·85	400 "
Wheat .	18·6 "	After melilotus, 26·9 bushels	8·3 "	6 50	46 "

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, IV.*

(*Continued from Bulletin for October.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

DECREASE OF MILK WITH ALTITUDE AND CONTINUOUS HUMIDITY.

(*Continued.*)

The fact that Castilloa yields little or no milk in elevated situations is commonly recognized in Soconusco, though it is not necessary to accept the popular impression that the difference is due to the mere fact of elevation. The temperature being lower and the atmosphere more humid, there is less rapid transpiration of moisture and less need at once of means of resisting dryness of maintaining the high pressure of fluids found in trees growing near sea level.

Decrease of temperature would also mean a decreased effect from dryness. If this interpretation of the function of rubber be correct, a region like the Isthmus of Tehuantepec, which might be suitable for coffee at relatively low elevations, would not for this very reason be favourable for rubber. It is also not to be assumed that a region in which the rubber tree grows wild is favourable for the production of rubber. The case is quite different from that of a seed or fruit crop. A plant is not likely to become established in a region where it can not ripen seed, but if rubber is an adaptation against unfavourable conditions, it might be dispensed with where the unfavourable conditions do not exist. That latex serves in

* Extract from U. S. Department of Agriculture, Bull. No. 49, Bureau of Plant Industry.

Castilloa as a protection against drought does not mean that it may not have other functions here and elsewhere. The problem of rubber culture is to encourage the formation of latex by placing the tree under suitable conditions.

In a dry atmosphere the transpiration—that is, the moisture given off by the leaves—is much greater, and as this water is taken up from the soil the amount of salts and other soluble substances taken into the plant with the water is also much increased. It is by no means impossible that substances obtained in this way are used in the formation of rubber, and if this be the case the tree would have, as it were, an automatic protective device ; the drier the weather the greater the quantity of rubber-forming materials and the greater the protection against dry weather. It is possible even that the thickening of the milk might finally impede the circulation of water and be itself the cause of the falling of the leaves, as Parkin observed with the leaves of Hevea. The falling of the leaves in the dry season would thus be an indication of conditions favourable for rubber culture rather than the reverse, as some have supposed. It is not at all impossible that a rubber tree might grow best in a region where it would not yield the maximum quantity of rubber, and, conversely it may be found that the most rapid growth of the trees does not insure the largest yield of rubber. If it be true that rubber is a dry-weather product, the limitations of rubber culture on this side are in securing enough rain to permit rapid growth. One problem would be to find out how much of a dry season is necessary for best results. Too much dry weather would mean slow growth, too much rain decrease formation of rubber, and these factors would vary even in the same neighborhood and with different seasons. The prospects of particular localities for rubber can not be ascertained by the tapping of a few trees in each at the same date or in the same month. A tree in which the pressure in the milk tubes was too low or the milk too thick to flow out in the dry season might yield abundantly at the beginning of the rains, while in a more humid locality the fluctuations would be much less.

That rubber could be obtained from one tree in the dry season and not from another might mean merely that the former had access to a larger supply of water and was thus able to maintain a greater latex pressure. Such questions will need to be studied in detail after uniform methods of tapping and pressure measurement have been devised. This need not obscure the fact that unless tapping be done at the most favourable date, the productiveness of rubber trees and the localities in which they grow may be misjudged very easily.

CASTILLOA IN NICARAGUA.

The opinion that the production of rubber by Castilloa is favoured by a dry season is based, as yet, only on observations made in Guatemala and southern Mexico : other conditions and different species of Castilloa may be found in the countries to the south-

ward. Moreover it is scarcely reasonable to expect the interested public to adopt what may appear to be a radical view of Castilloa culture without understanding the basis of the current opinion that continuously humid regions are required for the production of rubber.

The report on the Caoutchouc of Commerce, written by James Collins, and published in 1872 under the auspices of the British Government remained for many years the most complete and authoritative statement of the subject. It was very frequently quoted by subsequent writers, and has probably done most to establish the idea that continuous humidity is required by Castilloa. Collins says:

> The species of Castilloa seem to like best and thrive in thick, humid, warm forests. They abound in Nicaragua; and as I have, through the kindness of my friend Dr. Bureau, of Paris, received from M. Paul Lévy, a botanical collector in Nicaragua. a good account of their history there, it will serve to give a correct idea of their habits.
>
> The basin of the Rio San Juan is where the ule tree grows to perfection. This river is the natural vent of the two vast basins of the lakes of Nicaragua and Managua, receiving numerous tributaries, which have all their sources in the innumerable tract hitherto virgin and unfrequented, and where the trees abound. The ground is very fertile. The district is very unhealthy; it rains for eight or nine months in the year, and the climate is very warm and humid. The trees prefer humid and warm soils, but not marshy, clayey, or gravelly ground, and the presence of these trees is looked upon as an indication of a fertile soil. . . The ule is often near water-courses, and nearly always on the banks.*

CASTILLOA IN COSTA RICA.

The most extensive recent publication on Castilloa is by Herr Th F. Koschny, a resident of Costa Rica, whose opinion on the subject of climate appear to be nearly opposite to those stated above. He says:

> The safest and most productive rubber plant is the *Castilloa elastica* of Central America. Its tenacity of life and adaptability to soil and climate are seldom exceeded by other trees; the same is also true of the quantity and quality of the rubber.
>
> It requires a humid, warm climate, and with respect to rainfall less depends upon the amount of precipitation than upon the distribution of it. The shorter the dry season and the more the rain extends over the entire year the better will a locality be adapted for rubber culture; regions with a long, absolutely dry season are unsuitable for this culture In the valley of San Carlos, Costa Rica, upon the Atlantic slope, it rains occasionally also in the dry season, and even in the two driest months, March and April. The Pacific slope of Central America has, on the contrary, a completely dry season of four months, and two months at the beginning and end with little rain. Both the wild and the planted rubber trees die there at the third tapping at the latest, in case this takes place in the dry season.†

If the above statement represents a general fact in Costa Rica it can only be said at present that either the climate, or the rubber trees, or both, are different from those of southern Mexico. In spite of six months of dry weather the rubber trees at La Zacualpa

* Collins' Report on Caoutchouc, p. 14.
† Beihefte zum Tropenpflanzer, 2: 119, 1901.

have reached maturity in the open sun, and have survived many and severe tappings.

It may not be without significance that the conditions with which Herr Koschny is most familiar and which he considers favourable for rubber production are not those of continuous humidity, for there is a dry season of two or three months. In eastern Guatemala, an interesting example of the rapidity with which the tropical sun can dry out the vegetation was observed. Our party arrived at Panzos during a heavy rain, and rode the next day toward Senahu over muddy roads through the dripping leaves of a luxuriant tropical growth. Three weeks later the same region was dry and parched, and even the leaves of the undergrowth of the forest were shrivelled.

CASTILLOA ON THE ISTHMUS OF PANAMA.

The idea that the Castilloa sent from the Isthmus of Panama to British India came from a continuously humid district seems not to be justified by the statements of Mr. Cross, who secured seeds and cuttings in the vicinity of Colon. He says:

The interior of the Darien forests would frighten most people. The undergrowth is composed of boundless thickets of a prickly leaved species of *Bromelia* often 8 to 10 feet high, the ground swarms with millions of ants, and the snakes raise themselves to strike at anyone who approaches.

The Caucho tree grows not in inundated lands or marshes, but in moist, undulating, or flat situations, often by the banks of streamlets and on hillsides and summits where is any loose stone and a little soil. It is adapted for the hottest parts of India, where the temperature does not fall much below 74° F. The tree is of rapid growth, and attains to a great size, and I am convinced that, when cultivated in India, it will answer the most sanguine expectations that may have been formed concerning it. I have been up the Chagres and Gatun rivers. I came out on the railway about 7 miles from Colon. I go back to the same place (the village of Gatun), from which place by the river the India-rubber forests are reached.*

The undergrowth of Bromelia indicates a relatively barren, open forest with a severe dry season, and this supposition is strengthened by the allusion to the ants, snakes, "loose stones," and "little soil."

ANALOGY OF THE ASSAM RUBBER TREE.

The fact that the production of rubber may fail under conditions which permit the luxuriant growth of the trees is not new, since it was recorded with reference to Assam rubber tree as early as 1875, as shown in the following extract:

The production of different kinds of caoutchouc in India continues to engage the attention of the India Office and of this establishment. One fact in connection with it which seems to require very careful consideration has been pointed out by Mr. Mann in his report on the caoutchouc plantations in Assam. It is found that although the *Ficus elastica* will grow with undiminished rapidity and luxuriance in situations remote from the hills, it fails to yield caoutchouc. Mr. Mann concludes that no greater mistake could be made than to start plantations of *Ficus elastica* in any part of Bengal. It appears, therefore, judging from this case, that conditions which may insure the successful growth of caoutchouc-yielding trees may not be sufficient to determine their producing caoutchouc.†

* Trans. Linn. Soc., London 2d ser., 2: 213.

† Report on the Progress and Condition of the Royal Gardens at Kew during the year 1875, p. 7.

(*To be continued.*)

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 13th September, 1904, at 11.15 a.m. Present: His Excellency the Hon. Sydney Olivier, Chairman, the Director of Public Gardens, the Chemist, His Grace. the Archbishop, the Superintending Inspector of Schools, Hons' H. Cork and J. V. Calder, Messrs C. A. T. Fursdon, J. W. Middleton and the Secretary, John Barclay.

Cattle disease.—As regards the cattle disease reported to exist in St. Ann, the Secretary stated that Mr. Perkins of Walker's Wood, had lately been losing mules and cattle and that their spleens were found to be rotten. He had asked for a fuller account of the symptoms of illness and conditions of environment.

Mr. Middleton suggested that the Board should call the attention of the Government to the subject and suggest that in case of infectious diseases in live stock there should be compulsory isolation of the stock.

Mr. Calder said he thought the trouble would turn out to be anthrax which was more or less common in the island, but was less prevalent than it was formerly. He thought samples of blood should be sent to the Chemist for identification of the disease. The only thing to be done was to rest the pastures, lime the spot where the animals died and burn the carcases.

Botany at Hope and Agriculture in Secondary Schools.—The report of the Committee was read as follows :—

The sub-committee of the Board of Agriculture appointed at the last meeting of the Board to confer with regard to arrangments for carrying on instruction in Botany to the students in agriculture at Hope, met at the Government Laboratory on Friday, the 26th of August. Present—His Excellency the Acting Governor, the Director of Public Gardens and Plantations, the Island Chemist and Mr. J. W. Middleton.

After full discussion it was decided that in the coming term Mr. Teversham should give a course of lectures on Elementary Botanic Morphology under Mr. Fawcett's direction in order to prepare for a more advanced course in Economic Botany which it was hoped Mr. Fawcett would be able to give hereafter.

The committee then, in conference with the Chairman of the Jamaica Schools Commission considered the possibility of utilising the Jamaica College and other Secondary Schools as a means of preparing and attracting youths towards the study of agriculture. It was agreed that the Chemist should confer with the Chairman of the Schools Commission and such other educational authorities as it might be convenient to consult with a view to enabling Secondary Schools so to adjust their curriculum as to meet the requirements of the aim approved.

The Chairman suggested that the Board might ask the Archbishop, the Superintending Inspector of Schools, Mr. Cousins and

the Hon. J. V. Calder to form a permanent committee of the Board, and the members could consult with the headmasters of prominent schools with a view to coming to an arrangement as to the teaching of agriculture in schools.

The Archbishop said there might be difficulties in the way of country schools. There should be no privileges allowed to the Jamaica College which could not be equally available to other schools, but recommendations were easier carried out there owing to its proximity to Kingston. It ought to be possible for us to do for agriculture in Jamaica what was being done in Barbados.

The Chairman said the Committee might be invited to consider and submit recommendations to open the Jamaica Scholarship for Agricultural Scholarships.

School gardens—The Chairman then read a minute from the Chemist upon School Gardens and essential changes in the Code, pointing out that a considerable number of teachers had now been trained, that the present regulations of the Code tended rather to discourage than encourage the general establishment of School Gardens and making suggestions whereby the grants for agricultural object lessons and School Gardens should be so increased that all country schools would find it necessary and profitable to take up this work.

The Chairman announced that it had been decided by the Government to appoint a special committee to enquire into the matter and to make recommendations.

Cotton.—The Secretary submitted the following matters in connection with the cotton industry :—

(a) Copy of letter from Sir Daniel Morris stating that he would probably visit Jamaica in October in company with two cotton expert buyers, who would come to the West Indies on behalf of the British Cotton Growing Association, and that he was impressed by the high opinion that had been formed of West Indian Cotton in Liverpoool, where brokers had assured him they could receive at least 30,000 bales of Sea Island Cotton without affecting prices.

(b) Letter from the Hon. T. H. Sharp informing the Board that he was prepared to buy seed cotton and ginned cotton of every variety and all that the island could produce, if the seed cotton was delivered at Spanish Town and the ginned cotton at 3 Orange St., Kingston. He would give the very highest price possible and submit account sales of cotton sold in England for the Secretary to fix price.

(c) Secretary's report on the cotton industry as follows :—

That he had forwarded one of the cotton hand gins to Mr. J. Shore and one to the Secretary of the Black River Agricultural Society ; that the freight was to be charged to the account of the £100 grant received from the British Cotton Growing Association ; that the other two hand gins were stored pending disposal by the Board ; that he had applications from Messrs. R. L. Young, L. A. Hopwood

and A. J. Webb of St. Ann for one of the hand gins to be placed in that parish, and if this was granted, Mr. J. H. Levy of the Jamaica Products Co., had promised to take charge of it; that instead of shipping the cotton grown at the Prison Farm and that grown by the settlers on the Pedro Plains to Liverpool he had offered to dispose of it to Mr. Sharp at the highest market price, so as to save trouble and delay; that he had visited the experimental plot at Shortwood and found it in excellent condition; that he had arranged with the acting principal to receive the seed cotton and have it ginned: that he had asked for reports from all the experimental plots, but had only received two so far, both reporting failure, but that the cotton on the other plots was nearly all ready to be picked, and he would get complete reports by the end of the month.

Tobacco—The Director of Public Gardens submitted further information on tobacco growing under shade in Connecticut and Florida and submitted sketches of the tobacco houses in use there for curing.

The Chairman read a minute from the Chemist on the subject suggesting that a capable officer of the Department should be sent to Florida to get information about Sumatra tobacco there.

The Chairman said they had no funds availnble to send any one to Florida; the rest of the Board concurred.

After discussion it was decided that they should go on with another experiment in growing Sumatra tobacco on the same lines as last year, but that the Director should find out all that was being done in Cuba and Florida and remedy as far as possible the defects in the system of curing.

A letter from the Colonial Secretary was submitted stating that on the suggestion of the Commissioner of the Imperial Department of Agriculture for the West Indies, Mr. F. V. Chalmers of Liverpool, a tobacco expert, proposed visiting Jamaica, and that the Board might make such arrangements as they thought useful in connection with his visit.

Locked still at Denbigh—The Secretary submitted replies of the members of the Board to the Chemist's minute to the Chairman.

Mr. Calder, Mr. Middleton, Mr. Shore and Mr. Cork objected to the expenditure on Denbigh estate.

After considerable discussion on the subject Mr. Calder moved that the Board should postpone decision until detailed plans and specifications and full data of cost were submitted. Mr. Cork seconded, and this was agreed to.

Water Buffalo—Mr. Cork stated that he had seen the Indian Water Buffalo being used in parts of thesouthern United States, introduced there from the Philippine Islands, and he would suggest that they might be imported here to be used in the swamps of Westmoreland and St. Elizabeth.

Rice—Mr. Cork asked that endeavours might be made to get the people to plant rice in St. Elizabeth.

The Secretary was instructed to write the Travelling Instructor for that district to see what steps could be taken in this direction.

Chemist's Reports—The Chemist submitted the following reports :—

(*a*) Arrangements for examination for diploma and Agricultural Scholarship,—suggesting that Prof. D'Albuquerque of Barbados should conduct the examination for the diploma, at a fee of £10 to be paid out of the vote for special instructors and that the services of an examiner for three Agricultural Scholarships should be obtained at a fee of £5 out of the same vote.

It was agreed to recommend this to the Government.

(*b*) Progress Report—Manurial experiments.
(*c*) Work of Sugar Department for month.

Reports Director of Public Gardens :—

(*a*) Hope Experiment Station from 13th August to 10 September.
(*b*) Mr. W. J. Thompson on school gardens visited.
(*c*) Copy of letter from Mr. J. Ch. Sawer, Brighton, England, on Vanilla.
(*d*) J. T. Palache, Travelling Instructor, on school gardens visited.
(*e*) Mr. Cradwick's work for August.

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EDITED BY

WILLIAM FAWCETT, B.Sc., F.L.S.,

Director of Public Gardens and Plantations.

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Vol. II. DECEMBER. 1904. Part 12.

THE TOBACCO OF JAMAICA.

CIGAR LEAF WRAPPER AT HOPE GARDENS.

Extract from Annual Report of Director for year ended 31st March, 1904.

For the purpose of testing the possibility of producing in Jamaica the expensive imported wrapper tobacco, experiments have been conducted with Sumatra tobacco under tent cloth on the lines practised in the Connecticut valley in America. A quarter of an acre was laid out on a site occupied by Havana tobacco last year, the tent being erected over two distinct kinds of soil; one half a very heavy black soil and the other the result of an outcrop of sandy loam or gritty loam. The plants grew equally well upon both soils, reaching a height of 9 feet in 49 days after planting.

The results of the experiment to date show that a very fine grade of wrapper can be grown in Jamaica, equal, if not superior to that imported from America, but to insure correct curing, the crop must be grown in a locality a great deal more humid than Hope. The leaves should take from 16 to 20 days to dry, turning yellow first at the tip and upwards to the midrib, closely followed by the brown; whereas at Hope, some of the pickings dried in two days, the leaves remaining a green colour. Mr. T. J. Harris thinks that it is safe to advocate the cultivation of this valuable crop only in such districts as Upper Clarendon and Temple Hall.

Sumatra tobacco should be grown in the ordinary tobacco season—August and September to March and April; at Hope the seeds were sown at the end of August in seed boxes under shade the seedlings planted out under the tent from the middle to the end of October; were weeded and moulded middle of November, and the first ripe leaves picked on the 12th of December—three

and a half months from the date of sowing. The tent proved to be the most expensive part of the experiment costing £39 9s. 7d. the labour bill came to £3 8s. 3d.

Mr. T. J. Harris says that "it must be remembered that in conducting an experiment of this kind, a great many difficulties have to be overcome, and in this case the only one that was beyond us was the controlling of the atmospheric conditions in the curing-house during the drying of the tobacco; it was thought that adequate measures had been taken to cope with this contingency by daubing the walls of the house and fixing in shutters; but the dryness of the climate was all-pervading; if it is proposed to grow another crop at Hope next season the house will have to be closeboarded and fitted with a steaming apparatus. It is my opinion, however, that nothing further is required to demonstrate that Sumatra wrapper can be successfully grown and cured in Jamaica provided the work be undertaken in the localities named."

REPORT BY MR. F. V. CHALMERS.

Mr. F. V. Chalmers to the Honble. the Colonial Secretary.

26th October, 1904.

Sir,

I have the honour to report the result of my examination of the tobacco grown in this island.

Generally speaking, I find the tobacco of good quality and flavour. But the majority of the leaves are of a heavy nature, consequently from a commercial point of view such tobacco cannot compete with other productions for the purposes of cigar wrapper in particular and for cigar purposes generally, because when tobacco is of a heavy nature it is obvious that the weight of a given number of leaves is greater than when the tobacco is of a finer texture. This is a most important point when competing for market with a country like Great Britain where the duty is very high.

The quality of the tobacco, that is to say the flavour or aroma, is in nearly every instance excellent.

The foregoing remarks apply to the great proportion of the tobacco now being produced, but I think that if more attention was given to the soil upon which this tobacco is grown so that it was made of a lighter nature, a finer and a lighter tobacco from every point of view might be produced.

It must always be remembered that tobacco cannot be produced or determined by a chemical analysis. The quality of some vegetable productions is largely decided by a determinate of its starch, such as the potato or maize and other percentages, but tobacco appears to be determined only by the senses of man; colour, texture, aroma and combustibility are the points by which the quality of

tobacco is estimated. Organic and inorganic salts seem to have considerable effect on these qualities. The organic compounds seem to bear a closer relation to the aroma of the tobacco while on the inorganic salts depends largely the combustibility. A large proportion of potash in the tobacco improves the burning and when potash is present in the form of a carbonate the best results are obtained.

The growers of bright tobacco find that the tobacco grown on the land immediately after the ploughing under of a leguminous crop is deficient in texture and colour. The bright tobacco planters frequently allow their land to grow up to grass and weeds for a year and plough this under that they may have the land in the best condition for a fine crop, but this is a system applied to the production of American tobacco, viz.: Virginia, which is of a strong nature and might not apply for the production of a fine cigar leaf, but the value of wood ashes as a rule can be safely relied upon as a good expedient.

I now come to the shade-grown tobacco which has been produced at Hope Gardens, and I am pleased to be able to report that with one or two objections in the leaf the product has every appearance, when perfected, of being a type of tobacco which is hardly likely for the purpose of cigar manufacturing, principally from a wrapper point of view, to be excelled by any other tobacco of the world, and from the estimate prepared by the Hon. W. Fawcett of the cost of such production, a very lucrative industry should, in my opinion, arise in Jamaica.

But let me clearly say that the tobacco must be produced in a thin, good colour, that is to say, a light, level colour, free from spots and of a strong texture; and last, but by no means least, a positive knowledge as to fermentation must be applied or the whole proceeding will be a failure, because two fatal conditions will arise, viz.: the flavour or aroma of the tobacco will not be perfect and the tobacco will be tender and on account of its extreme thinness very liable to break and consequently would be useless as a cigar wrapper. And tobacco that is essentially grown for the purpose of wrapper is in nearly every instance the least good for any other part of a cigar, and furthermore to produce a fine cigar wrapper such as I firmly believe can be produced in Jamaica would present a competitive quality only to be found in the very picked of Cuban productions, viz.: it will contain a delicious flavour, which should make it very valuable indeed, more especially as it is universally admitted that at the present time there was never so much tobacco and it was never so bad. This remark applies in particular to the whole production of Havana.

Hitherto as far as my experience goes the tobacco of Jamaica has never been used as a pipe tobacco, but having regard to the great depreciation of American tobacco generally and the general desire of smokers for a mixture or blend of tobaccos of varying

flavours, I see no reason why this excellent tobacco, though of a thick nature, should not form one of the ingredients in such mixtures for the pipe. With that end in view, it is my intention to bring the matter before some of the manufacturers of Great Britain. In conclusion, permit me to tender my best thanks for all the courtesies and kindnesses extended to me by every one here and sincerely trust that our mutual efforts may be of some avail.

I have, etc.,

F. V. CHALMERS.

ESTIMATES GIVING THE COST OF PRODUCTION OF TOBACCO GROWN UNDER SHADE.

The prices given for materials are about the average values at the present time, but anyone going into the construction of shade must understand that the prices will vary a little according to the market.

The actual amount of material and labour required for the construction of shade for an area of 200 feet by 216 feet (approximately 1 acre) is given in estimate No. 1.

The estimated yield per acre is based upon the following description of a typical Sumatra plant :—

Height of plant when in flower 8 to 10 feet.
Length of longest cured leaf 18 to 20 inches.
Length of shortest cured leaf 8 to 10 inches.
Average length of cured leaf 14 inches.
Width of largest cured leaf 10 to 12 inches.
Width of smallest cured leaf 5 to 6 inches.
Average width of cured leaf 8 inches.
Greatest number of leaves on best plant 40.
Lowest number of leaves on plant 20.
Average number of leaves on plant 30.
Average bottom or sand leaves unmerchantable 3.
Average top and injured leaves 7.
Weight of the average number of the merchantable leaves from one plant 1·35 ozs.
Distance apart in rows 15 inches.
Distance of rows apart 3 feet.
Number of plants per acre if full 12,600.
Failures say 1,000.
Average stand 11,600.

If the plants average 20 merchantable leaves, and weight is 1·35 oz. then 250 leaves weigh a pound, and one acre produces 232,000 leaves and weighs 928 lbs. but take 800 lbs. per acre as a fair average.

Estimate No. 1—Calculated at the present price of imported timber in Kingston, the present price of cloth in America, freight, commission and other charges from America to Kingston:

	£	s.	d.	£	s.	d.
128 Posts 4″ x 4″ x 12′ 2048 feet @ 13/ per 100 feet ...	13	6	3			
100 Stringers 2″ x 4″ x 20′ 1333 feet @ 13/ per 100 ft. ...	8	13	4½			
880 ft. of baseboard 1″ x 6″ 440 ft. @ 14/ per 100 ft. ...	3	1	7			
36 Stringers 2″ x 4″ x 12′ 288 ft. @ 13/ per 100 ft. ...	1	17	5¼			
60 Posts 4″ x 4″ x 14″ 90 ft. @ 13/ per 100 ft. ...	0	11	8¼			
113 lbs. No. 9 wire (1,944 ft.) @ 19/ per 112 lbs. ...	0	19	1¾			
292 lbs. No. 12 wire (10,005 ft.) @ 19/ per 112 lbs. ...	2	9	6¼			
38 lbs. No. 8 wire (645 ft.) @ 19/ per 112 lbs ...	0	6	5¼			
24 lbs. nails ...	0	4	6			
20 lbs. nails ...	0	4	2			
8 lbs. staples ¾″ ...	0	2	0			
10 lbs. staples 1¼″ ...	0	1	6			
Approximate cost of labour in constructing framework ...	5	10	0	37	7	7¼
4840 square yds. shade cloth @ 3·8 cents yd. ...	36	15	9			
1264 square yards shade cloth @ 3·8 cents yd. ...	9	12	2			
One sixth duty on value of cloth	7	14	7½			
Freight to Kingston ...	2	8	0			
Commission at 2½% ...	1	3	2			
Clearance and other charges	0	12	6			
Approximate cost of labour in construction of shade ...	3	10	0	61	16	2½
Cost of cultivating and curing 1 acre				15	10	0
Cost of materials, labour in construction, cultivation and curing, £114 13s. 10d.				114	13	10

Yield (low average) 800 lbs. of cured leaf per acre.

Cost per lb. 2/ 10¼.

Estimate No. 2—Calculated on getting posts locally, price of imported timber in Kingston, the present price of cloth in America, freight, commission and other charges from America to Kingston.

	£	s.	d.	£	s.	d.
128 Posts 12 ft long ...	4	16	0			
100 Stringers 2″ x 4″ x 20′ 1,333 ft. @ 13/ per 100 ft. ...	8	13	4½			
880 ft. of baseboard 1″ x 6″ 440 ft. @ 14/ per 100 ft. ...	3	1	7			
36 Stringers 2″ x 4″ x 12′ 288 ft. @ 13/ per 100 ft. ...	1	17	5¼			
60 Posts 4″ x 4″ x 14″ 90 ft. @ 13/ per 100 ft. ...	0	11	8¼			
113 lbs. No. 9 wire (1,944 ft.) @ 19/ per 112 lbs. ...	0	19	1¾			
292 lbs. No. 12 wire (10,005 ft.) @ 19/ per 112 lbs. ...	2	9	6¼			
38 lbs. No. 8 wire (645 ft.) @ 19/ per 112 lbs. ...	0	6	5¼			
24 lbs. nails ...	0	4	6			
20 lbs. nails ...	0	4	2			
8 lbs. staples ¾″ ...	0	2	0			
10 lbs. staples 1¼″ ...	0	1	6			
Approximate cost of labour in constructing framework ...	5	10	0	28	17	4¼
4840 square yards of shade cloth @ 3·8 cents per yd. ...	36	15	9			
1264 sq. yards of shade cloth @ 3·8 cents per yd. ...	9	12	2			
One sixth duty on value of cloth	7	14	7½			
Freight to Kingston ...	2	8	0			
Commission at 2½% ...	1	3	2			
Clearance and other charges	0	12	6			
Approximate cost of labour in construction of shade ...	3	10	0	61	16	2½
Cost of cultivating and curing 1 acre ...				15	10	0
				106	3	6¾

Cost of materials, labour in constructing, cultivation and curing £106 3s. 6¾d.

Yield (low average) 800 lbs. of cured leaf per acre.

Cost per lb. 2s. 7¾d.

Estimate No. 3—Calculated on using imported timber for posts, No. 9 wire, instead of imported timber for stringers, the present price of shade cloth in America, freight, commission and other charges from America to Kingston.

	£	s.	d.	£	s.	d.
128 Posts 4″ x 4″ x 12′ 2,048 ft. @ 13/ per 100 ft. ...	13	6	3			
116 lbs No. 9 wire (2,000 ft.) @ 19/ per 112 lbs. ...	0	19	8			
880 ft. of baseboard 1″ x 6″ 440 ft. @ 13/ per 100 ft. ...	3	1	7			
24 lbs. No. 9 wire (432 ft.) @ 19/ per 112 lbs. ...	0	4	0			
60 posts 4″ x 4″ x 14″ 90 ft. @ 13/ per 100 ft. ...	0	11	8¼			
113 lbs. No. 9 wire (1,944 ft.) @ 19/ per 112 lbs. ...	0	19	2			
292 lbs. No. 12 wire (10,005 ft.) @ 19/ per 112 lbs. ...	2	9	6¼			
38 lbs. No. 8 wire (645 ft.) @ 19 per 112 lbs. ...	0	6	5¼			
24 lbs. nails ...	0	4	6			
20 lbs. nails ...	0	4	2			
8 lbs. staples ¾″ ...	0	2	0			
10 lbs. staples 1¼″ ...	0	1	6			
Approximate cost of labour in constructing framework ...	5	10	0	28	0	5¾
4,840 sq. yards of shade cloth @ 3·8 cents per yd. ...	36	15	9			
1,264 sq. yards of shade cloth @ 3·8 cents per yd. ...	9	12	2			
One sixth duty on value of cloth	7	14	7½			
Freight to Kingston ...	2	8	0			
Commission at 2½% ...	1	3	2			
Clearance and other charges	0	12	6			
Approximate cost of labour in construction of shade ...	3	10	0	61	16	2½
Cost of cultivation and curing 1 acre				15	10	0
				105	6	8¼

Cost of materials, labour in constructing, cultivation and curing £105 6 8¼ yield (low average) 800 lbs. of cured leaf per acre.

Cost per lb. 2/7½.

No. 4.—Calculated on getting posts locally, using No. 9 wire instead of imported timber for stringers, and the present price of shade cloth in Ameriea, freight commission and other charges from America to Kingston.

	£	s.	d.	£	s.	d.
128 posts, 12 ft. @ 9d. ...	4	16	0			
116 lbs. No. 9 wire, (2,000 ft.(@ 19/ per 112 lbs. ...	0	19	8			
880 ft. of baseboard 1′ x 6″ 440 ft. @ 14/ per 100 ft. ...	3	1	7			
24 lbs. No. 9 wire (432 ft.) @ 19/ per 112 lbs. ...	0	4	0			
60 posts 4″ x 4″ x 14″ 90 ft. @ 13/ per 100 feet ...	0	11	8¼			
113 lbs. No. 9 wire (1,944 ft.) @ 19/ per 112 lbs. ...	0	19	2			
292 lbs. No. 12 wire(10,005 ft.) @ 19/ per 112 lbs. ...	2	9	6¼			
38 lbs. No. 8 wire (645 ft.) @ 19/ per 112 lbs. ...	0	6	5¼			
24 lbs. nails ...	0	4	6			
20 lbs. nails ...	0	4	2			
8 lbs staples ¾′ ...	0	2	0			
10 lbs. staples 1¼′ ...	0	1	6			
Approximate cost of labour in constructing framework ...	5	10	0	19	10	2¾
4,840 sq.-yards of shade cloth @ 3·8 cents per yard ...	36	15	9			
1,264 sq.-yards of shade cloth @ 3·8 cents per yard ...	9	12	2			
One-sixth duty on value of cloth	7	14	7½			
Freight to Kingston ...	2	8	0			
Commission at 2½% ...	1	3	2			
Clearance and other charges	0	12	6			
Approximate cost of labour in construction of shade ...	3	10	0	61	16	2½
Cost of cultivation and curing, 1 acre ...				15	10	0
				96	16	5¼

Cost of materials, labour in construction, cultivation and curing £96 16s. 5¼d.

Yield (low average) 800 lbs. of cured leaf per acre.

Cost per lb. 2s. 5d.

Calculating on the wood-work to last for 5 years, putting on new cloth each year, cultivation and curing.

No. 1 estimate, cost per lb. 2/2½.
No. 2 estimate, cost per lb. 2/0¾.
No. 3 estimate, cost per lb. 2/0¾.
No. 4 estimate, cost per lb. 2/0¼.

SHADE-GROWN TOBACCO IN UNITED STATES AND CUBA, AND TOBACCO IN SUMATRA.

From Messrs. Amory, Browne & Co., New York, to Director of Public Gardens, and Plantations, Jamaica.

29 Thomas Street, P.O. Box, 690.
August, 31st 1904.

Dear Sir,

The writer has been requested by Mr. R. W. Lees, to write you with regard to the comparative yields per acre between tobacco grown in the sun and tobacco grown under cloth in the respective cigar leaf districts.

In reply I would say that I should be glad to assist you in any possible way to get at such exact information as you may desire, and shall in this letter only discuss the question in general terms.

It may be laid down in a general way that the culture of tobacco under cloth makes a greater yield than sun grown in the southern tobacco districts, and makes a smaller yield per acre than the sun grown in the northern districts. This is due in the north to the fact that different varieties of tobacco, of less yield, are preferred for use under cloth, the product being much finer than the outdoor types that are common in these regions. In Connecticut, for instance, the outdoor tobaccos, called Connecticut Havana seed and Connecticut broadleaf, produce from 1,600 to 2,000 pounds per acre, while Sumatra and Cuban seed, which are there preferred for planting under cloth, do not yield more than from 800 to 1,100 for Cuban and from 1,000 to 1,350 for Sumatra. This deficiency in weight is made up by the thinness and fine quality of the leaf, as compared with the sun-grown.

It is due to say, however, that where the outdoor-grown seed of Connecticut tobaccos (Havana seed and broadleaf) is grown in Connecticut under cloth, the yield per acre is usually reduced from 1,600 to 2,000 to 1,250 to 1,600 owing to the fact that the leaf is thinner. The capacity for covering cigars, by the pound of leaf, is, however, increased. These native tobaccos have not, as yet, been largly grown under cloth in Connecticut, the smaller-leafed types of Sumatra and Cuban being preferred.

Perhaps the best comparison in Connecticut as to respective weights is shown in the case of Sumatra tobacco: small plots of this have been planted in the sun, near the cloth-covered field, and the yield per acre in the sun is much less than that under cloth, the plants not getting anything like the growth that those under cloth attain.

In Florida the acreage of sun-grown is decreasing, so that it is

not so much of a factor in the trade there, but there is an increase of about 60 per cent. in the yield per acre when the same seed is planted under shade.

In Cuba there is the greatest increase in the amount of wrapper obtained by the use of cloth, but as the yields are there figured in carrots and bales, the comparison is not readily obtained. Wrapper in the sun is largely dependent upon the freedom of the field from the attacks of insects. The actual weight of tobacco under cloth is there probably twice that obtained in the sun, as the plants of the same seed grow to a height of 16 to 18 good wrapper leaves, where outdoors they are limited to eight or ten. The same holds true of Porto Rico.

Regarding the acreage of sun-grown tobacco in these districts concerning which, I believe you also made inquiry : The acreage under shade has had no effect upon the acreage of sun-grown in the places named, except that in Florida there is less sun-grown than formerly. The Connecticut Valley has about 16,000 acres of cigar wrapper tobacco in the sun ; Cuba, I am told, 30,000 acres, or more ; and Porto Rico, perhaps 10,000 acres.

As to the curing of Sumatra tobacco. The practice in the States is to prime the leaves one by one and string them upon lath, about 36 leaves to the lath, and the lath placed in the shed about five or six inches apart on each tire. The ventilation of the sheds depends entirely upon the weather, the idea being to get enough alternate dryness and dampening so that the cure will not be too rapid : about four to six weeks is a common period for primed Sumatra tobacco. This primed tobacco does not get the brown colour in the shed that other tobacco, harvested on the stalk, does, but many of the leaves remain a tea green. This colour comes out in the fermentation, which is done in bulks of about 4,000 pounds, the pile being built up on a little platform, six feet wide by twelve feet long. The temperature in the middle of the pile is allowed to go up to about 124° Fahrenheit, and the tobacco is then changed around ; and that which was on the top and bottom being placed in the middle, that which was on the outside being placed in the inside of the pile, which is now made up on an adjoining platform. About six to eight weeks, with a turning each week, is usually required. Assorting should be done as soon as possible, so that the tobacco, after it is sweat, will not dry out by standing before assorting; the application of water being thought not beneficial.

I should be glad to answer any specific inquiries for you.

The weights above discussed are of tobacco shed-cured.

It may interest you to know that information just arriving from Sumatra is to the effect that several plantations are changing from priming to curing on the stalk. This is Sumatra tobacco sun-grown.

Yours respectfully,

(Sgd.) PAUL ACKERLY,

for Amory, BROWNE, & CO.

SWEET POTATO TRIALS, 1904.

By H. H. COUSINS, M.A., F.C.S., *Island Chemist.*

The value of the sweet potato has been brought home to the people of Jamaica by the great benefits it conferred on the community after the destruction wrought by the hurricane of 1903 as a quick growing crop of high nutritive qualities for providing a speedy supply of food. The Agricultural Society distributed a large quantity of slips received from Barbados and the Prison Farm at Spanish Town. It is believed that the large crops of sweet potato grown all over the island did a great deal to alleviate the position of the peasantry during the past year.

The sweet potato has been the subject of special experiments by the Imperial Department of Agriculture for the West Indies and Mr. Hart of Trinidad has already issued seedling varieties of great promise. To test the comparative merits of the sweet potatos available in Jamaica, sixteen varieties were grown at the Hope Experiment Station in plots each of $\frac{1}{40}$ acre. At the end of seven months' growth (February to October) the tubers were lifted, weighed, sampled for analysis and submitted to a test as to cooking qualities. No irrigation was employed. The rainfall during the period of growth was as follows :—

1904	March	...	7·51 inches.
	April	...	4·11
	May	...	1·63
	June	...	9·67
	July	...	1·28
	August	...	1·76
	September	...	5·21
	Total	...	31·17

It is suggested that under irrigation some of the varieties, such as Thompson's Favourite for instance, would have yielded much more favourable results.

The general experience seems to be that the sweet potato is rather an erratic crop upon which to carry out field experiments and the yield of tubers in this series can not be regarded as in any way a final estimate of the comparative merits of the sixteen varieties.

The results as recorded by Mr. Cunningham of the Experiment Station, together with his personal estimate of the eating quality of each variety are as follows :—

No.	Name of Variety.	Shape of Leaf.	Colour of Stem.	Colour of Tubers.	Size of Tubers	Quality when cooked.	Yield per acre.				Remarks on growth.
						Flavour—	Tns.	cwt.	qrs.	lbs.	
1	Fire Brass	Cordate	Green	Pale Red	Very large	Good	11	0	0	0	Vigorous
2	Moffard	,,	,,	Red	Large	Excellent	9	11	3	4	Medium
3	White Gilkes, 6 mos.	5 Lobed	,,	White	Large	Good	9	16	1	20	,,
4	Trinidadian	Cordate	Purple	Red	Medium	Very good	11	0	0	0	,,
5	Vincentonian	5 Lobed	Green	Red	Medium	Good	8	13	2	8	,,
6	White Sealy	Cordate	,,	White	Very large	Good	7	1	1	21	Vigorous
7	Trinidadian No. 2	,,	,,	Pale Red	Very large	Very good	11	7	2	8	,,
8	Brass Cannon	,,	Purplish Green	Red	Very large	Good	8	9	1	4	Medium
9	Caroline Lee	3 Lobed	Green	Yellowish White	Large	Excellent	5	16	0	8	,,
10	Red Sealy	Cordate	,,	Red	Medium	Very good	8	4	1	4	,,
11	White Gilkes, 3 mos.	5 Lobed	Yellowish Green	Yellowish White	Medium	Excellent	7	1	1	21	Vigorous
12	Thompson's favourite	Cordate	Purple	White	Medium	Very good	6	12	3	12	,,
13	Tailor's Scissors	5 Lobed	,,	Red	Medium	Good	2	11	1	20	,,
14	Roosevelt	3 Lobed	Yellowish Green	White	Medium	Good	1	9	1	4	Very vigorous
15	Minuet	Cordate	Green	Yellowish White	Large	Very good	10	8	3	20	Medium
16	Governor	5 Lobed	Purple	Red	Medium	Excellent	3	3	2	8	Vigorous

Trinidadian No. 2 gave the largest yield, viz., 11 tons $7\frac{1}{2}$ cwt This variety gives very large cordate tubers of good quality—"Trinidadian No. 1" and "Fire Brass" come second with a yield of 11 tons.

I am inclined to place Trinidadian No. 1 in the highest position and to class it as the best variety in this series on account of the high quality of the tubers both in total solids and in starch and sugars. Our results with this new Trinidad seedling are such as to warrant its general trial by the people all over the island.

Chemical Analyses.

Samples of all the varieties were sent to the Laboratory and records taken of the average weight of a tuber, its general appearance and of the flavour when cooked. The latter was decided upon by a small committee consisting of a chemist and three experienced black ladies. On the whole their verdict is in substantial agreement with the opinions of Mr. Cunningham which were arrived at quite independently and based upon different samples of the tubers.

The variety with the highest percentage of total solids is "Governor" with the very high content of 39.8 per cent. Trinidadian No. 2 gave the lowest result with 30.58. Even this is far above the average American sweet potato which contains only 29 per cent. of total solids.

The variety "White Sealy," heads the list in starch content with 30·94, a truly extraordinary amount. The lowest starch content is that of "Fire brass" with 23·74 per cent.

The sugars vary from 2·94 per cent. in "Thompson's favourite" to only 0·232 per cent. in "Fire brass,"

The fibre shows little variation (·567 to ·828).

The nitrogen content varies from 0·7 in Thompson's favourite (= 4·7 per cent of protein) to 0·16 in Trinidadian No. 2 (= 1 per cent. protein).

A determination of amides in the variety "Tailor's scissors" indicated that rather over one-fifth (22·2 per cent) of the total nitrogen exists as amides.

The results shown by the analyses of this series of varieties indicate that the sweet potato as grown in Jamaica is a food of very high quality. The bulk of the solid matter consists of starch. The standard of solids and of starch shown by this collection of varieties is far in excess of that obtaining with sweet potatoes grown in the United States and places the tropical product in a very favourable position by comparison. With regard to the 'sweetness' of the sweet potato, the indicated proportion of sugars is not enough to account for the sweet taste of the tubers when cooked and eaten.

To test whether the process of cooking increased the sugar content, an experiment with the variety Trinidadian No. 1 was carried out.

	Moisture %.	Total solids %.*	Starch %.	Glucose %.	Total sugars %.
Uncooked ...	69·45	30·55	25·3	0·099	1·6
Cooked ...	69·99	30·01	21·63*	4·31*	7·69*

* Calculated on same content of total solids as uncooked,

This result is very striking. *The process of cooking the sweet potato has increased the glucose from 0·1 per cent. to 4·3 and the total sugars from 1·6 to 7.69 per cent.*

Experiments are now being undertaken to ascertain the exact chemical nature of this change. I believe that this fact has not hitherto been recorded and that it explains why a sweet potato should taste so sweet when eaten despite the moderate amount of actual sugars in the raw tuber.

Experiments were also undertaken to indicate the change in the tubers on keeping. Tubers of the variety 'White Sealy' were analysed when freshly dug and after keeping for 5 weeks in the open air.

The results were as follows :—

	Moisture %.	Total solid %.	Glucose %.	Total sugars %.
Fresh tubers ...	67·19	32·81	0·244	1·1
Old tubers ...	69·45	30·55	0·434	4·0

This indicates that the tubers tend to a development of sugars at the expense of other constituents on keeping.

These preliminary results suggest various lines of enquiry which we hope to follow up as opportunities occur.

ANALYSIS OF SWEET POTATOS.

No.	Name.	Average weight. lb.	oz.	Appearance.	Flavour, etc. when cooked.	Per Cent. Total solids	Moisture.	Starch	Glucose.	Total sugars.	Fibre.	Total nitrogen.	Remarks
1	Fire Brass	1	$15\frac{1}{4}$	Colour light pink, inside yellow	Flavour very good. Mealy	32.79	67.21	23.74	–	0.232	0.579	0.49	
2	White Gilkes, (6 months)	1	$4\frac{1}{2}$	White skin and inside	„ Moderately good	35.81	64.19	24.96	–	0.339	0.638	0.25	
3	Moffard	1	$4\frac{3}{4}$	Skin deep pink, inside yellow	„ Excellent. Mealy	33.48	66.52	23.84	0.38	2.2	0.698	0.42	
4	Vincentonian	1	$9\frac{3}{4}$	Skin deep pink	„ Very good. Mealy. Tasted sweeter than 5	33.53	66.47	29.40	0.24	0.95	0.667	0.28	
5	White Sealy	1	10	Skin white, inside yellow or white	„ Excellent. Firmflesh. A favourite	32.81	67.19	30.94	0.24	1.1	0.653	0.21	
6	Trinidadian No. 1	1	3	Pink	„ Very good	33.87	66.13	28.26	0.21	2.2	0.665	0.28	
7	Brass Cannons	3	2	Skin deep pink	Insipid generally disliked Firmflesh	32.99	67.01	25.81	0.38	2.5	0.663	0.22	
8	Caroline Lee		$9\frac{3}{4}$	Skin white	Flavour very good. Stringy	37.03	62.97	28.41	0.77	2.5	0.655	0.25	
9	Trinidadian No 2	1	$4\frac{1}{4}$	Skin pink	„ Very distinctive. Soft. Sweet	30.58	69.42	22.43	0.5	2.85	0.637	0.16	
10	Tailor's Scissors	1	$0\frac{3}{4}$	Skin pink, inside yellow streaked with pink	„ Good, but not as good as 15 Firmflesh	36.69	63.31	29.12	0.5	2.17	0.723	0.45*	*Albuminoid N.=0.35 % *Amide N.=0.10 %
11	White Gilkes, (3 months)		$12\frac{1}{4}$	Skin white	Sweet Firm flesh	39.32	60.68	29.37	0.36	2.86	0.699	0.35	
12	Governor	1	5	Skin deep pink	Flavour excellent. Texture fine	39.82	60.18	28.69	0.42	2.2	0.692	0.39	
13	Roosevelt		7	White	„ Fairly good. Soft	33.72	66.28	25.14	0.5	2.86	0.828	0.39	
14	Red Sealy		$12\frac{3}{4}$	Skin light brown, inside white	„ Good. Mealy	33.24	66.76	28.19	0.66	2.75	0.567	–	
15	Minnets		$9\frac{1}{4}$	Skin white, inside yellow	„ Very good. Firmflesh	32.23	67.77	27.83	0.37	2.7	0.604	0.35	
16	Thompson's Favourite		15	Skin & inside white	Very mealy-like a yam. No marked flavour	33.29	66.71	28.12	0.35	2.94	0.557	0.7	

COTTON IN JAMAICA.

It may be of interest when there is a good prospect of a revival of the cotton industry in Jamaica, to note what the historian, Long, said on the subject 130 years ago. The following paragraphs are taken from the History of Jamaica, published in 3 volumes, London, 1774:—

This shrub was probably brought into the island by its ancient inhabitants from the South American continent. It is propagated by the seed, which is sown, about five feet asunder, at the latter end of September, or beginning of October, and at first but slightly covered. After it springs up, and becomes a plant, the root is well moulded. The seed is subject to decay, when it is set too deep, especially in wet weather. The soil most proper for it, should not be stiff, nor shallow, as this plant has a tap-root. The ground is hoed frequently, and kept very clean about the young plants until they rise to moderate height; otherwise they are apt to be destroyed by caterpillars. It grows from four to six feet, and produces two crops annually; the first in eight months, from the time of sowing the seed; the second, within four months after the first; and the produce of each tree is reckoned about one pound weight. The southside planters generally cultivate it in May and gather in the January following; but unless they have rain between January and April, which more often fails than happens, they rarely make much of the second crop; for which reason September seems to be a fitter season for planting the seed, as it will have certain rains in October, to establish its vegetation; and, being gathered about May, the flowers, which may probably fall in the succeeding weeks, promise to ensure a tolerable second crop. The seed is set in regular lines at the distance before mentioned, so as to let the branches spread freely, which however are sometimes pruned, if the soil be too rich, and their growth over-luxuriant; and they are likewise pruned or trimmed constantly after the first gathering. When the pods are come to maturity, they burst open, and disclose their seeds, intermixed with the flock or wool. When great part of the pods are thus expanded, the crop begins, the wool is picked, and afterwards cleared from the seeds by a convenient machine, of very simple contrivance, called a gin, composed of two or three smooth, wooden rollers, of about one inch diameter, ranged horizontally, close and parallel to each other, in a frame; at each extremity they are toothed, or channeled longitudinally, corresponding one with the other; and the central roller, being moved with a treadle or foot-lath, resembling that of a knife-grinder makes the other two revolve in contrary directions. The cotton wool is laid, in small quantities, at a time, upon these rollers, whilst they are in motion, and readily passing between them drops into a sack placed underneath to receive it, leaving the seeds (which are too large to pass with it) behind. The wool thus discharged from the seeds, comes afterwards to be hand-picked, and cleansed thoroughly from any little particles of the pods or other substances

which may be adhering to it. This is a tedious though necessary operation; but it is easily performed by children or invalids, who are fit for no other work; it is then stowed in large bags, where it is well trodden down by a negro, whilst it is thrown in, that it may lie close and compact, and the better to answer this purpose, some water is every now and then sprinkled upon the out-side of the bag. This operation is performed in a shady place, that the moisture may not evaporate too suddenly. The weight of a marketable bag is usually 300lb. and that weight per acre may be expected from plants.

To bring therefore the profit of this cultivation into view we may suppose a planter possessed of ten able negroes, and twenty acres in cotton, the produce may be rated as follows;—

Acres.	No. of Plants.	Produce lb w.	Bags.	Price sterl. gross per lb	Gross profit, £ sterl.	
20	6,000	6,000	20	1/	300	1st crop.
	do.	3,000	10	do.	150	2nd crop.
		9,000	30	Total	£450	per an.

In the parish of Vere, 240 lb. weight per acre, is reckoned tolerably good yielding; this makes the produce of twenty acres 4,800 lb. weight which falls short of the above computation; for an average therefore of rich and poor land, good or indifferent seasons, we may take 270 lbs. per acre.

One negro labourer will gin from 50 to 60 lbs. per day. Three negroes will therefore gin the above quantity in about 54 days at a medium; consequently, such a planter will have leisure sufficient during the year, for attending to corn, provisions, and other articles.

All our fustians, calicoes, Manchester velvets, &c., are made up by the help of this commodity; and it therefore contributes to maintain a very capital part of the commerce of Britain and Ireland; for these stuffs are in demand in all quarters of the world to which our trade extends; and particularly in those countries which are situated within the tropics. Nor can there be any sort of clothing better adapted to hot climates; for they readily imbibe the moist vapours of the skin, without repelling them like linen; nor do they

decay so soon. It is supposed that not fewer than 120,000 persons are constantly employed in England in different branches of the manufacture of this single staple. There is but little of it worked up at the places of its growth, except in the fabric of hammocks, and even this little branch has never yet reached Jamaica. In some parts of the island, as in Vere, a few industrious housewives make knitted stockings with it for their families; and some few planters spin their own wick for lamps in crop time; but, probably not a third of a bag is spent in this way, as the greater number buy what is imported from Great Britain.

In this example we have a proof of the great comparative value of the West Indian colonies, which do not rival Great Britian in manufactures, over those which are dangerous competitors with her. This disparity begins from the very verge of the Tropics, and grows more visible the further we recede from thence to the northwards. In the Carolinas, I have been informed that the planters have in general so great a number of looms at work, as to be able to clothe their black and white labourers with a coarse fabric of cotton cloth: they save by this means, a heavy annual charge, being the *growers.* as well as *manufacturers.* If the Jamaica planters were to pursue the same scheme, and each to set up a loom in his house, the loss to Britain would be near £300,000 sterling per annum; but such establishments only take effect in very populous colonies, where the people are too poor to buy, can afford cheap labour, are not over nice in their clothing, and cannot give their time or hands to more lucrative purposes.

In Jamaica it is not worth while to enter upon such a manufacture; because, upon computation, it would come to a higher price than a better fabric imported from the mother country; because labour can be applied to more gainful works; because the inhabitants are fond of being well dressed; and, lastly, have a variety of staples, which require too constant attention to give them leisure for attending the loom.

The Indians of the island, when it was discovered by Columbus, manufactured this article into hammocks and apparel. Nature having denied fleeces to the sheep of these climates, this vegetable wool seems to have been given them as a substitute; and it is certainly the best appropriated, and wholesome material for a tropical dresss.

The seeds are esteemed efficacious in the bloody flux; and an oil is obtained from them by expression, which supplies the boiling-house lamps on some plantations.

THE CULTURE OF THE CENTRAL AMERICAN RUBBER TREE, V.*

(*Continued from Bulletin for November.*)

By O. F. COOK, Botanist in charge of Investigations in Tropical Agriculture, U. S. Department of Agriculture.

THE PARA RUBBER TREE IN HUMID LOCALITIES.

Following the original publication of James Collins, in 1872, writers on rubber have continued to emphasize the humidity of the forests of the Amazon basin.

The Amazon valley is remarkably for uniformity of temperature and for regular supply of moisture. From June to December is the dry season, and January to May the wet. In the dry season in November there are a few occasional showers, and during the wet season intervals of fine weather. * * * On the banks are *dense* moist forests, with caoutchouc trees interspersed. Dr. Spruce, when at Barra, in December 1850, found that the rains had set in some weeks previous, and from December 10 to the beginning of the following February only a single day occurred without some rain. In February there were six fair days; in March, the most rainy month, only one; and to April 18 but three days of fine weather. During March the highest tempera ure was 84½°; many days it failed to reach as high as 80°.

On the Solimoens. or upper Amazon, the sea breeze is not felt, and it is therefore more stagnant and sultry. The whole of the country along its banks is covered with one uniform, lofty, impervious, and humid forest. The soil nowhere sandy, but always either a stiff clay, alluvium, or vegetable mould. The vegetation is very prolific and the atmosphere densely vaporous.†

It is difficult to explain why the heavy rains and over-flowed rivers have been dwelt upon with so much persistence and the six months of dry weather left quite out of account, particularly since it has been known from the first that the rubber is obtained in the dry season, and Collins himself states that in the wet season the milk is poor in rubber, or "too aqueous to allow of profitable collection."

The late Mr. Jenman, government botanist of British Guiana, has described similarly the conditions which he considered typical for *Hevea spruceana*:

The water lies in shallow pools between the trees, or is spread in sheets, when deeper, over wide spaces of ground, and the surface soil generally, especially where this tree most abounds, is hardly more firm or dense than mud. It will give an idea of its character when I say that I wore a pair of high-laced-up shooting boots, but with the best care of moving about, and stepping mostly on the more solid soil which is usually found in hillocks around the butts of trees, or on the fallen bits of wood which stretch between them, in spite of my care, I was constantly sinking to their tops and over, so that my socks were covered with mud. I am speaking, as I have said, of the wet season of the year, but even in the dry the ground continues in a very moist condition. The land is usually very densely shaded, and in many places, probably in consequence, produces very little undergrowth.

I have taken the occasion to describe rather fully the character of the land, as it is important that persons contemplating the cultivation of this species of Hevea should be well informed as to the conditions which prevails in its native haunts.‡

It is, of course, to be expected that different species of Hevea will be found to prefer different natural conditions but the above account, while well showing what even explorers have been ex-

* Extract from U. S. Department of Agriculture, Bull. No 49, Bureau of Plant Industry.

† Collins, J. Report on the Caoutchouc of Commerce p. 6.

‡ Timehri, 2; 14, 1883.

pecting to find, has little real bearing in rubber culture in view of the extreme difficulty of carrying on agricultural operations in such a country. Moreover the average maximum yield obtainable by the destruction of full-grown trees is placed by Mr. Jenman at 1 pound, which was several times greater than what could be secured by tapping.

PRODUCTIVENESS OF PARA RUBBER TREES IN DRY SITUATION.

A Para rubber tree in the Botanic Garden at Penang, on the Malay Peninsula, is noteworthy as having a reliable record of six tappings in five years, with a total of 15 pounds and 10 ounces of rubber. The tree was set out in 1886, and was about eleven years old before it was tapped. Some of the incidents, as related in the following paragraph, are not without interest:

No particular attention was paid to these trees at the time more than to the many other economic and ornamental plants that were planted in this garden that year, then in course of foundation, and it so happened that two were planted side by side on poor gravelly soil on sloping ground, which, by the subsequent cutting of a new road alongside them some years later, converted the site on which they are growing into what is virtually a dry bank. When, some ten years after these trees were planted, the questions of the best method of extracting and coagulating rubber, and the probable yield to be expected, commenced to interest the planting community, this tree as been the largest in the garden, was selected for experiments, which have been continued from time to time and the result recorded in the annual reports. There is nothing remarkable about this tree except that, as planters have often remarked, it is remarkably small for its age, but that is not surprising, considering the nature of the soil and the situation in which it is growing.*

Notwithstanding the apparently unfavourable conditions and the rather severe treatment to which it has been subjected, the tree is described as in healthy condition, with all its wounds healed. It has a height of about 55 feet and a girth of 66 inches, having increased from 36 inches in 1897, when tapping was commenced.

THE TRUE CLIMATE OF HEVEA.

The results of the writer's observations on Castilloa were so much at variance with prevalent opinions concerning climatic requirements that the possibility of a similar error having been made with reference to Hevea naturally suggested itself, and various indications like the preceding were found in the literature of the subject suggesting that this might prove to be the case. Shortly afterwards there appeared the following quotation from a paper written by Mr. H. A. Wickham, who made the original introduction of Hevea seeds from Brazil to British India, and whose testimony is so direct and conclusive that we need wonder only that so important a point should have been so long overlooked:

But as all the stock of plants or seeds available for the planting and cultivation of this tree in the Eastern Tropics are and will be derived from direct lineal descendants of some or other of those 7,000-odd originally introduced by me at the instance of the Government of India in 1876-77, it may be well if it be recollected that their exact place of origin was in 3° of south latitude, and to remember their natural conditions there. This the more so since a very general error seems to have obtained that swampy or wet lands are the fitting locality for the Hevea. This would seem to have arisen in that the "explorer" of a few years'

* Agricultural Bulletin of the Straits and Federated Malay States, 1: 385. August 1902

experience would have some of these trees pointed out to him (naturally in answer to inquiries) growing scattered along in the wet margins in going up the lower Amazon or tributaries, whereas the true forests of the Para Indian rubber trees lie back on the highlands, and those commonly seen by the inquiring traveler are but ill-grown trees which have sprung up from seeds brought down by freshets from the interior.

As a matter of fact, the whole of the Hevea which I procured for the government of India where the produce of large grown trees in the forests covering the broad plateaus dividing the Tapajos from the Madeira River. The soil of these well-drained, wide-extending forest-covered table-lands is stiff, not remarkably rich, but deep and uniform in character. The Hevea found growing in these unbroken forests rivals all but the largest of the trees therein, attaining to a circumference of 10 feet to 12 feet in the bole. These forest plains having all the character of wide-spread tablelands occupy the space betwixt the great arterial river systems of the Amazon, and present an escarped face, which follows at greater or less distance and abuts steeply on the igapo or bagas, *i.e*, the marginal river plains subject to inundation by the annual rise of the great river. So thorough is the drainage of this highland that the people who annually penetrate into these forests for the season's working of the rubber have to utilize certain lianas (water-bearing vines) for their water supply, since none is to be obtained by surface-well sinking, in spite of the heavy rainfall during a great part of the year.*

(*To be continued.*)

BOARD OF AGRICULTURE.

The usual monthly meeting of the Board of Agriculture was held at Headquarter House on Tuesday, 11th October, 1904, at 11.15 a.m. Present: the Hon, H. Clarence Bourne, Colonial Secretary, in the chair, the Director of Public Gardens, the Government Chemist, His Grace the Archbishop, the Hons. J. V. Calder, and T. Capper, Messrs. C. A. T. Fursdon, C. E. de Mercado, J. W. Middleton, and the Secretary, John Barclay.

A letter to the Director of Public Gardens was read informing the Board that His Excellency had appointed the Colonial Secretary to be chairman in the room of the Hon. Sydney Olivier, C.M.G.

Cattle Disease.—With regard to the cattle disease in St. Ann, the Secretary reported that as directed he had asked Mr. Perkins to send on the spleen of an animal that had died and to give him full particulars of the symptoms the animals showed and the conditions of their environment, but that Mr. Perkins had not replied.

After discussion Mr. Fursdon moved that the Board ask the Government to take powers, if they have not already got the same similar to the powers possessed by the Imperial Government for the prevention of the spread of disease in live stock, modified if required to suit local circumstances, and that steps be taken to procure a copy of the British law or laws on the subject.

This was approved of.

The Secretary was asked at the same time to get further particulars, if possible, of the disease under notice.

Locked Still at Denbigh.—Mr. Cousins submitted estimates in connection with the locked still proposed to be put in at Denbigh Estate. He said that unfortunately the plans and specifications had been sent to the Crown Agents and only one drawing had

* Agricultural Bulletin of the Straits and Federated Malay States, September, 1902, pp. 476–477.

been made. The Acting Governor had thought that it was necessary to carry through this matter quickly in time for the estate crop coming on, and his instructions had been acted upon.

Mr. Middleton said he saw the same drawing or a copy of it in the office of the stationmaster at May Pen the day before and perhaps it could be got.

Mr. Calder said he had asked for full details, both of the estimated cost and of the plan and specifications and these should have been submitted to the Board to show whether this matter had reasonable hopes of success, before it was carried through.

Mr. Calder then explained the whole position to the Chairman. He said that the matter had once been fully discussed at a large and influential meeting of the Agricultural Society attended by many of the largest sugar planters, that protest had been made to the Government against it and since then the matter had been held in abeyance. He held that if it was carried through it would be absolutely ruinous to Jamaica rum. He desired to protest, and to have his protest recorded, against a matter like this being brought before the Board for discussion when it had already been settled by the Government. The same thing had occurred once before and it was a waste of time for him to come there to advise in a matter in which evidently no advice was wanted. If this thing went on, he did not think there would be any use in his remaining a member of the Board.

Mr. deMercado said there was certainly no use in the members of the Board attending meetings to advise the Government on matters already settled, and he would not propose to sit on the Board under such conditions. It would be fatal to the Board if the public knew that the members had not been consulted in an important matter like this or in any matter affecting agriculture.

Mr. Fawcett asked if the Board were not constituted trustees of the Sugar Experiment Fund, and whether any money could be spent without its authority?

The Chairman said the functions of the Board were advisory, but the Governor would of course consult it on all agricultural matters. He thought it was within the power of the Government to spend the money and that the Board had no final power; but he would look up the law on this subject.

Mr. Cousins explained that the late acting Governor was keen on having this matter carried through, and thought the cost could be included in the expenditure of £1,000 for machinery already allocated by the Board and as there was little time left Mr. Olivier had taken the matter in hand himself, and he (Mr. Cousins) had acted on his initiative.

The Archbishop said that there were elements of considerable difficulty and irritation in the matter and he felt that Mr. Calder had right to feel aggrieved, but he would ask him not to treat it as a case affecting his position on the Board. There was no doubt that the present case had resulted in some muddling, but the Acting

Governor no doubt thought that he had power to act as he did and it was most deplorable that it was only now made known to the members of the Board that the order had already been given to buy the machinery. He hoped no more orders would be made like this. Mr. Calder should be supplied with particulars of the plans and if he found anything wrong he would no doubt communicate with the Chairman. He would propose that it should be minuted that this matter had been dealt with by the late Acting Governor in the exercise of his own power and that the Board did not desire to carry through the matter of the Locked Still at Denbigh: that Mr. Cousins be requested to place full data and plans in the hands of Mr. Calder, and that these full particulars should also be circulated. This was agreed to.

Visit of Sir D. Morris—As regards the visit of Sir D. Morris and two cotton experts, it was left with the Chairman and Mr. Fawcett to make arrangements to receive him and to arrange a programme to make their visit as useful as possible.

Tobacco expert—As regards the visit of the tobacco expert, Mr. F. V. Chalmers expected to arrive on the "Port Kingston," it was left to Messrs. Fawcett & deMercado to meet him.

Water Buffalo—Mr. Fawcett said with reference to Mr. Cork's letter at last meeting recommending that particulars should be got as regards the importation of Water Buffaloes here, Mr. Sewell had imported them at Home Castle estate in St. Ann and he found on enquiry that he still had two cows which he would be glad to sell at £10 each.

The Chairman said that the Water Buffalo had also been imported into Trinidad but after experience of them, there was no demand for them. The herd were for some years on the government pastures and were ultimately disposed of. It might be worth while to make enquiry of Mr. Maiden, the manager of the stock farm, as to what had become of them. The Secretary was instructed to do this.

Tobacco under shade—The Secretary submitted a letter from Messrs. Amory, Brown & Co., New York, to the Director of Public Gardens with regard to the growing of tobacco under shade. This was directed to be circulated.

Mr. Cork re Foodstuffs for dry Districts—The Secretary read a letter from Mr. Cork asking the Board to consider the advisability of informing the Instructors to advise the people in the dry districts to plant cassava, guinea corn, gungo peas and sweet potatoes. The Secretary said that with exception of guinea corn these products were always regularly grown in dry districts and that this year the growing of guinea corn had been especially advocated; that he had sent out a good quantity of seeds to local Agricultural Societies and individuals in the districts mentioned for planting, and that next year there would likely be appreciable supplies available.

Cotton—The Secretary submitted a report on the cotton industry

for the month, stating that he had forwarded one of the hand gins to Mr. Levy, Brown's Town. Part of it had been found broken and had been returned and sent to the Engineering Department of the Railway to be repaired. This had been done and it had been sent back to Brown's Town.

There was another hand gin still on hand for which application had been made by Dr. Pringle who had grown experimental plots on most of his properties.

He had sold the cotton from the Prison Farm and from the Pedro Plains to the Hon. T. H. Sharp at 5d. and 6d. a lb. respectively amounting to £3 11s. and £3 2s. 4d., Mr. Fursdon had reported that a considerable quantity of Egyptian cotton seed from the Prison Farm cotton was available and the Secretary asked that it might be sent to him to distribute among Branch Societies; this was agreed to.

He had received from the experimental plot at Shortwood a first lot of 512 lbs. Sea Island Cotton which had been sent to the ginnery at Hartlands, and there was still about a third of the crop to be picked, he expected to dispose of the lint at 6d. to 9d. a lb. and the seed from 2d. to 3d. a lb.

He had not yet received reports of the final results of the experimental plots.

During the month he had visited cotton cultivations at Eltham, Angels, Inverness and Colbeck and found that there had been no great difficulty in the picking of the cotton, that the girls and boys employed increased the amount picked from 10 to 15 lbs. the first day up to 50 lbs. at the end of the first week.

The Secretary read a letter from Mr. Fursdon giving his experience in relative results of the growing of Sea Island and Egyptian cotton.

The following reports from the Chemist were submitted :—

(*a*) Draft stock for cane mills—Asking that a pair of steers for crushing the experimental plots of canes at the Laboratory, be bought at a cost of £25 from Mr. S. Soutar and stating that they would also come in useful for ploughing at Hope. This was approved of.

(*b*) Agricultural education at Government Laboratory.

(*c*) Agricultural education at Barbados.

These were directed to be circulated.

Reports from the Director of Public Gardens were submitted as follows :—

(*a*) Hope Experiment Station.

(*b*) Reports on programmes of the Instructors.

(*c*) Report on the results of 16 experimental plots of sweet potatoes.

These were directed to be circulated.

The meeting then adjourned.

[Issued 2nd December, 1904.]